# SYSTEMATICS AND NEW TAXA OF THE *VANNIUS* COMPLEX (HEMIPTERA: MIRIDAE: CYLAPINAE) FROM THE AUSTRALIAN REGION

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Erection of the tribe Vanniini and its placement in the subfamily Palaucorinae, as proposed by Gorczyca (1997), is rejected. An informal group, the *Vannius* complex (Cylapinae: Cylapini) is recognised, comprised of *Afrovannius* Gorczyca, *Austrovannius* gen. nov., *Paracylapus* Carvalho, *Vanniopsis* Poppius, *Vannius* Distant, and *Vanniusoides* Carvalho & Lorenzato. *Austrovannius* nov. gen. is described, including three new species, *A. platnicki* sp. nov., *A. scutica* sp. nov., and *A. xepenehense* sp. nov. New species belonging to existing genera within the *Vannius* complex are described, including: *Vanniopsis howense* sp. nov., *Vanniusoides asprokara* sp. nov. and *Vanniusoides melafrons* sp. nov. *Vanniopsis rufescens* Poppius, 1909 is redescribed and the male genitalia are illustrated for the first time. Illustrations of male and female genitalia are given for the new species. A cladistic analysis of the genera of the *Vannius* complex is presented and the systematic position of the complex is discussed. ❐ *Hemiptera, Miridae, Cylapinae, Vannius complex, Australian region.*

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The Cylapinae are a basal group of Miridae (Schuh, 1975) whose systematics and biology are probably the least known in the family. Schuh (1995) and Schuh & Slater (1995) rejected the notion of meaningful monophyletic infrafamilial groups within the Cylapinae, as suggested by previous authors such as Carvalho (1952, 1957: Bothriomirini, Cylapini & Fulviini). Gorczyca (1997, 1998) has attempted to clarify the supragenerie classification, although this author has recently rejected his own inital findings (i.e. *Vannius* complex as a tribe within the Palaucorinae).

Gorczyca (1997) recognised the *Vannius* complex as a monophyletic tribe of mirids because of the spatulate parempodia, a condition unique in basal Miridae. He recognised this complex as containing *Afrovannius* Gorczyca, *Austrovannius* gen. nov., *Paracylapus* Carvalho, *Vanniopsis* Poppius, *Vannius* Distant and *Vanniusoides* Carvalho & Lorenzato.

This work reports on an examination of new material from the Australian region, with new species described from the Australian mainland, Lord Howe Island, Fiji, New Caledonia and Vanuatu. This study also includes a broader overview of the systematics of the *Vannius* complex, with a description of three genera (*Austrovannius*, *Vanniopsis* and *Vanniusoides*) from the Australian region. In addition, the ingroup relationships of the *Vannius* complex are analysed, and their position within the Cylapinae is discussed.

The Cylapinae, as with most mirid subfamilies, are poorly documented for Australia. Cassis & Gross (1995) listed only nine genera and 11 species, yet existing collections indicate that the cylapine fauna of Australia, may be an order of magnitude more species rich. This work is part of a series on the systematics of the Miridae of the Australian region, and the results herein are the first record of the *Vannius* complex from Australia.

This paper is based on a study of existing collections from the tropical parts of the Australian region, including the southwest Pacific. A smaller collection of other specimens from New Caledonia has been examined but not included in this paper. This material represents at least another ten new species of *Austrovannius*, and it is apparent that material examined from each mountain top is an endemic species. This material will be the subject of a second paper, as we await the collection of additional specimens.

## MATERIALS AND METHODS

This study was based on about 100 specimens, borrowed from the Bernice P. Bishop Museum

(BPBM), the Queensland Museum (QM), the South Australian Museum (SAMA), and the University of Queensland Insect Collection (UQIC). Dr Roger Kitching (Griffith University) provided one specimen. The holotypes of *Austrovannius platnicki* sp. nov. and *A. xepenehense* sp. nov. are lodged in the Muséum National d'Histoire Naturelle, Paris (MNHP). Material was also collected by us during fieldwork on Lord Howe Island and New Caledonia, and is housed at the Australian Museum (AM). Geographic coordinates for specimens without such information were calculated using GIS techniques, and are given in brackets in the Materials section of the species descriptions.

All measurements are maximum lengths and the range for each species is given in millimeters. Abbreviations for morphometric characters are: BL = body length; HW = head width across eyes; IOD = interocular distance; HL = head length; PL = pronotal length; PW pronotal width at humeral angles; AII = length of second antennal segment; and, LL = labial length.

Scanning electron micrographs were prepared using techniques outlined in Bolte (1996) and Swearingen et al. (1997).

Colour images were captured using a Nikon DX1 digital camera fitted with an Infinity K2 long distance microscope and a CF-3 objective. Illumination was supplied by the Mieroptic ML-1000 fiber optics system with the images relayed directly to Nikon Capture 2 software.

The data were constructed and analysed using Winclada (Nixon, 1999) and NONA (Goloboff, 1999). The characters are unweighted and all multistate characters are unordered. The following three taxa were used as outgroups: *Bothriomiris lugubris* Poppius, *Peritropisca bituberculata* Carvalho and Lorenzato and an undetermined species of *Cylapocerus* Carvalho.

BIOLOGY. The biology of the basal suprageneric groups (Isometopinae, Cylapinae, Psallopinae) of the Miridae are subject to debate because of a lack of empirical evidence (Schuh, 1975, Cassis & Gross, 1995; Wheeler, 2001). Many researchers (e.g. Schuh, 1976; Carvalho & Lorenzato, 1978) have argued that Cylapinae are stenotopic in their habits, being associated with the mycelia and fruiting bodies of higher fungi, in habitats such as fallen logs and under bark. There are some observations that support the notion that cylapines are mycetophagous (Schuh, 1975). Most cylapines (aside from Bothriomirini and most members of the *Vannius* complex) are characterised by an extremely elongate labium, which is suggestive of fungal feeding. Unlike in the Aradidae, which are well documented fungal feeders, the labium of cylapines does not possess coiled stylets, and there have been no reports on the mechanism of cylapine feeding. Wheeler (2001) suggested that some cyalpines, particularly Fulviini, are predaceous.

There is very limited knowledge of the biology of species of the *Vannius* complex. We found a new species of *Vanniopsis* from Lord Howe Island, *V. howense* sp. nov., in lowland rainforest, associated with leaf mould of fallen palm leaves (*Howea fosteriana* Becc.). This microhabitat was characterised by dense matts of fungal mycelia and high moisture content. *V. howense* was found in association with other heteropteran taxa; *Acaraptera* Usinger & Matsuda (Aradidae), and two species of Reduviidae: Emesinae (*Emesopsis* sp. and *Atisne derelictus* Wygodzinsky). Similarly, *Vanniopsis rufescens* Poppius and the new species of *Austrovannius* have been collected amongst leaf litter in rainforests. These data provide indirect support that the *Vannius* complex, like other cylapines are associated with fungi. Other species of *Vanniopsis* are known from vegetation, including sweeping ferns. Chris Reid (pers. comm.) observed that *V. howense* was occasionally collected on ferns. *Vanniopsis crobylos* has also been collected from a low plant (*Elatostema* sp. [Urticaceae]). Together, the above data suggest that *Vanniopsis* species are epigaeic but frequent low vegetation during the day.

*Austrovannius* species are also primarily ground-dwelling, collected from either sieved litter or by pyrethrum fogging of fallen logs. Nothing is known of the biology of the species of *Vanniusoides* that are described in this work. Gorczyca & Konstantinov (2001) reported that *Vanniusoides clypeatus* Gorczyca & Konstantinov is found in a riparian habitat amongst stones.

There is also limited biological information for species of the *Vannius* complex from the Afrotropical and Neotropical regions. Gorczyca (1996, 1997) and Gorczyca & Konstantinov (2001) reported that *Paracylapus lestoni* is found on fungi, and species of *Vannius* are known from fruit and flowers.

HOMOLOGY AND TERMINOLOGY. A range of external morphological and genitalic characters are used to differentiate genera and species within the *Vannius* complex. Homology and terminology for non-genitalic characters are

consistent with those described in Cassis (1995 and references therein) and Cassis & Moulds (1995). The homology and terminology of the male genitalia follow Kelton (1959) for gross features, and Stonedahl (1988) for specific attributes of the endosoma. The homology of the male genitalia proposed by Kerzhner & Konstantinov (1999) is not employed in this work. We use the term endosoma to refer to the aedeagus distal to the secondary gonopore. The descriptions of the female genitalia are based on Slater (1950) and Davis (1955). Modifications to terminology for the female genitalia by Schwartz & Footitt (1998) are used.

*Colouration*. The colour of the body, particularly the dorsum is critical in differentiating species in the *Vannius* complex. Aside from *Vanniopsis crobylos* and *V. rufescens*, most taxa are determined by colour patterns of the dorsum, particularly of the pronotum and forewings. These patterns have a generalised form, which are partially characteristic the *Vannius* complex, and are composed of a pallid background, interspersed with species-specific red markings (Fig. 3). We refer to these patterns as disruptive colouration. In addition, there are associated red markings of lateral aspects of the head and the thoracic pleura. The colour patterning of the second antennal segment is valuable in discriminating genera and species, with All either banded (Fig. 3C) or concolorous (Fig. 3A,B).

*Texture*. The body of most taxa of the *Vannius* complex is smooth, aside from two species of *Vanniopsis* (*V. crobylos* and *V. rufescens*) which have a weakly rugose dorsum.

*Vestiture*. The vestiture of the *Vannius* complex is not significant taxonomically. In general, the setae are simple, usually bristle-like, and of sparse to moderate distribution (Fig. 3D).

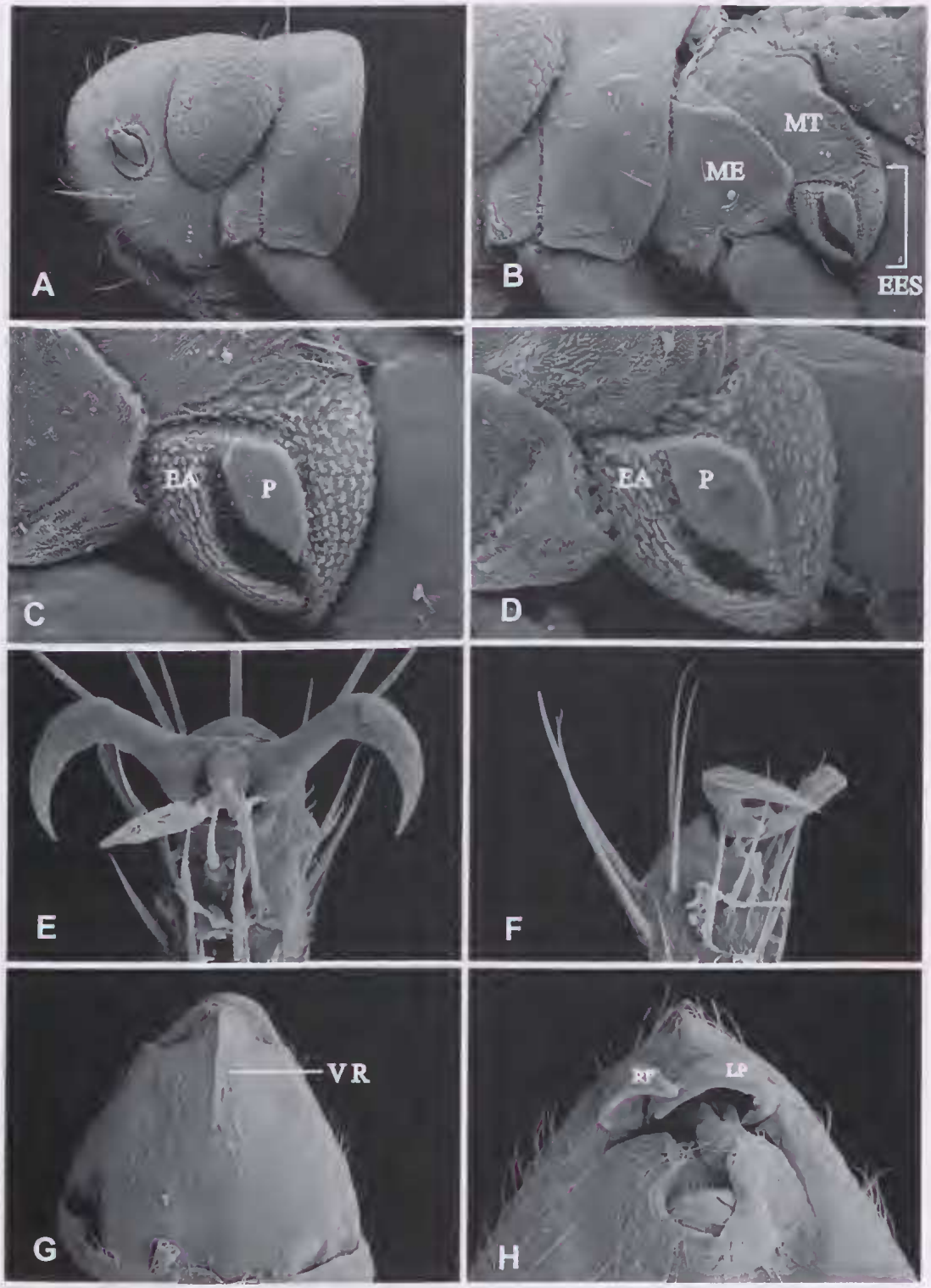
*Head*. The head is vertical in orientation (Fig. 1A), with the clypeus, and mandibular and maxillary plates cone-like, with the bucculae small and arcuate. The gular is consequently greatly reduced in size. Gorczyca (1997; figs 11-16) illustrated differences of the head between genera. There are some species differences found in *Vanniusoides*, where the clypeus and mandibular plates are apically rounded; cf. *V. clypeatus* (see Gorczyca & Konstantinov, 2001; fig. 4) and other *Vanniusoides* species. The most significant character examined was the presence of the longitudinal suture found on the vertex (and frons partially), which was either absent (*Austrovannius* and *Vanniusoides*) (e.g. Figs 3A, 6) or present (*Vanniopsis*) (Fig. 2A). In most taxa of the *Vannius* complex the antennae are much longer than the body and thread-like (e.g. Figs 3A,B,D, 6, 13). Antennal length is useful in differentiating species of *Vanniopsis*, with *V. crobylos* and *V. rufescens* (Fig. 3C) having relatively short antennae (as long as the body), whereas *V. howense* have the antennae significantly longer than the body (Fig. 13). The length of the first antennal segment is critical in determining *Vanniopsis*, having A1 much longer than the head (Figs 3A-C, 13). In other taxa of the *Vannius* complex, A1 is subequal in length to the head (Figs 3D, 6, 8). The length of the labium is not as significant, with most taxa having the labium reaching between the meso and metacoxae, aside from *Austrovannius*, which has an extremely elongate labium, reaching between abdominal sternum VII and the genital segments.

*Pronotum*. The flattened broad collar (Figs 3A-C, 2A, 13) is diagnostic for the *Vannius* complex. The collar is almost vestigial in *Austrovannius* (Fig. 1A), however, this is likely correlated to wing reduction. It is noteworthy that *Vanniopsis howense* also has staphylinoid wings (Fig. 13), but possesses a broad flattened collar. Other pronotal characters of significance include the campanulate pronotum (Fig. 3A-C), the undifferentiated disc (without calli) and the bisinuate posterior margin (Fig. 3A-C).

*Thoracic Pleura*. Thoracic pleura are largely uninformative, aside from the metathoracic spiracle and peritreme of the external efferent system of the metathoracic glands. The metathoracic spiracle is either concealed (Fig.1B) or exposed (Fig. 2C). The peritreme is either medially (Figs 1B-D, 2C) placed on the metepisternum, or adjacent to the anterior margin of the metepisternum, as in the remainder of the Cylapini (Cassis, 1995, fig. 128).

*Forewings*. Wing polymorphism is diagnostic at the genus and species levels in the *Vannius* complex. Staphylinoidy (*sensu* Schuh & Slater 1995) is diagnostic for *Austrovannius* (Figs 3D, 6, 8), *Vanniopsis howense* (Fig. 13) and *Vanniusoides brevis*. All other taxa of the *Vannius* complex are macropterous.

*Legs*. Legs are elongate in the *Vannius* complex, and are exaggerated in *Austrovannius* (Figs 6, 8), and some species of *Vanniopsis* (Fig. 13) and *Vanniusoides*. Tarsi are uniformly two-segmented in the *Vannius* complex. The pretarsus has spatulate parempodia (Fig. 1E,F), which is diagnostic and synapomorphic for the *Vannius*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complex. The absence (Fig. 1E) or presence (Fig. 2F) of subapical teeth is diagnostic at the generic level, and in some cases the number of teeth varies (Gorczyca, 1997).

*Male Genitalia.* The pygophore is diagnostic for certain genera. In most taxa the genital opening of the pygophore is dorsal in orientation (Fig. 1H), or rarely terminal (Fig. 2E). The ventral surface of the pygophore is impressed along the midline in *Austrovannius* (Fig. 1G). The structures of the aedeagus (Figs 5C, 7C, 9C, 12C, 14C, 15C, 18C) are of primary significance in determining genera and species in the *Vannius* complex. The presence of basal sclerites (Figs 5C, 7C, 9C, 12C, 14C, 15C, 18C) and the number and location of lobal sclerites (Figs 7C, 9C) of the endosoma are variable among genera, although their form is consistent within species. The secondary gonopore is either indistinguishable (*Vannius* and *Vanniopsis*) (Figs 12C, 14C, 15C, 18C) or strongly sclerotised and cup-shaped, with the aperture dentate (*Afrovannius*, *Austrovannius*, *Paracylapus*, and *Vanniusoides*) (Figs 5C, 7C, 9C).

*Female Genitalia.* The sclerotised rings (Figs 10A,C, 16A,C,E 19A,C) and associated ventral and dorsal labiate plates, as well as the inter-ramal sclerite and associated inter-ramal lobes (Figs 10B,D, 16B,D,F, 19B,D) are useful for distinguishing both genera and species of the *Vannius* complex. In *Austrovannius* the sclerotised rings (Figs 10A,C) and posterior wall (Figs 10B,D) and their associated components have a complexity of structure not found in either *Vanniopsis* and *Vanniusoides*. The species of the latter two genera have thin, simple, flattened rings (Figs 16A,C,E, 19A,C) placed between separate ventral labiate plates and wide, sometimes scroll-like, dorsal labiate plates. In contrast, species of *Austrovannius* have large, ornate, asymmetrical rings (Fig. 10C) between a convoluted, entire ventral plate and strongly sclerotised, but narrower, dorsal plates. Similarly the posterior wall of *Austravannius* species are complete (Fig. 10B,D), spanning the base of the first valvifers, with spinose and bulbous inter-ramal lobes. Species of *Vanniopsis* and *Vanniusoides* (Figs 16B,D,F 19B,D), in comparison, have slight, bilaterally separated inter-ramal sclerite with lobes.

## *VANNIUS* COMPLEX

DIAGNOSIS. The *Vannius* complex is recognised by the following combination of characters: head vertical (Fig. 1A); elongate thread-like antennae (Fig. 3D); pronotal collar broad and flat (Fig. 13); elongate metafemora (Fig. 3B); tarsi two-segmented (Figs 6, 8, 13); spatulate parempodia (Figs 1F, 2F); pretarsus lacking pulvilli or pseudopulvilli (Fig. 1E); and, endosoma with basal sclerites (strap-like and/or digitiform) (Fig. 5).

DESCRIPTION. *Colouration.* Body either stramineous to mostly red, if pale often with disruptive colouration (Fig. 3), with red markings on head, pronotum, thoracic pleura and forewings. Antennae often concolorous (Fig. 3B), stramineous to brown, sometimes with reddish highlighting, less commonly with AII banded (Fig. 3B). Legs often pale, sometimes femora with red banding (Fig. 3B). Abdomen either stramineous to red, often concolorous, less commonly dark, sometimes with paler regions ventrally.

*Texture.* Body smooth; impunctate; dorsum sometimes weakly rugose.

*Vestiture.* Body with sparse to moderate distribution of decumbent to semi-erect, pale to dark, soft to stiff (bristle-like) setae (Fig. 3D)

*Structure.* Macropterous (Fig. 3A-C) or staphylinoid (Figs 3D, 6, 8, 13); elongate to elongate-ovoid. Head subtriangular (Fig. 2A) to oval; transverse (Fig. 3A); vertical (Figs 1A, 2B); clypeus not visible from above, posteroventrally directed, usually flat, sometimes weakly swollen, sometimes with postclypeal processes; vertex flat to weakly convex (Fig. 2A), sometimes with weak depressions medially, often with shallow longitudinal sulcus (Fig. 2A); bucculae short, arcuate; mandibular plate greatly enlarged, triangular (Figs 1A, 2B); eyes enlarged, contiguous with anterior margin of pronotum (Figs 1A, 2A,B), not significantly extending beyond plane of head (Fig. 1A); ocelli absent (Fig. 2A). Antennae elongate, thread-like, at least as long as the body (Fig. 3D); AI weakly swollen,

FIG. 1. Scanning electron micrographs. A-C, E-G *Austrovannius xepenehense*, D and H *Austrovannius scutica*. A, head, lateral view; B, thoracic pleura, metathoracic glands, lateral view; C, peritreme and evaporative area; D, peritreme and evaporative area; E, strongly recurved tarsi, ventral view; F, tarsi, lateral view; G, pygophore, ventral view; H, pygophore dorsal view. EA = evaporative area, LP = left paramere, P = peritreme, RP = right paramere, VR = ventral ridge.

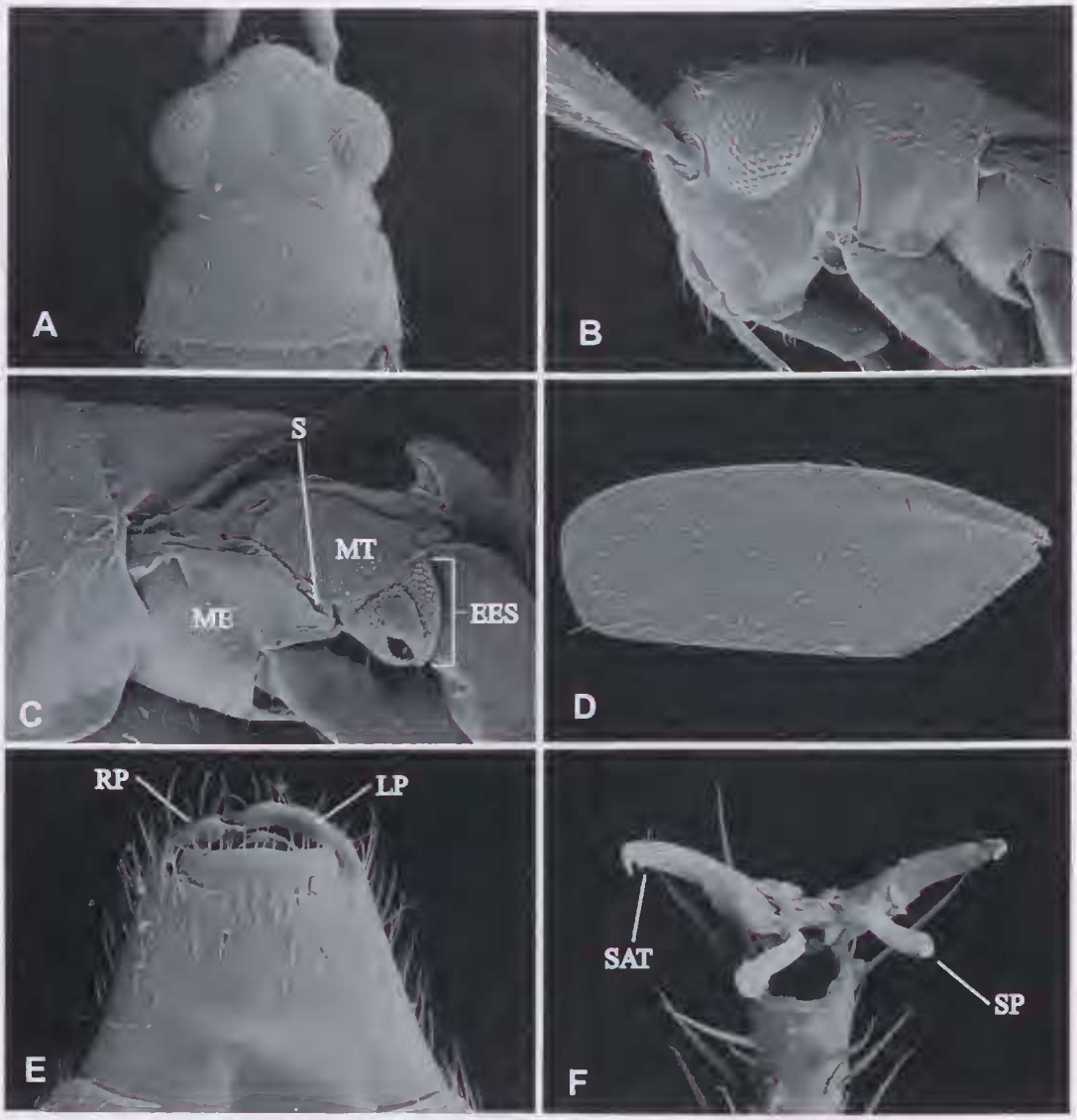


FIG. 2. Scanning electron micrographs. *Vanniopsis howense*. A, head and pronotum, dorsal view; B, head and pronotum, lateral view; C, thoracic pleura, lateral view; D, forewing, dorsal view; E, pygophore, dorsal view; F, pretarsus, ventral view. EES = external efferent system of metathoracic glands, LP = left paramere, ME = mesepimeron, MT = metepisternum, RP = right paramere, S = metathoracic spiracle, SAT = subapical tooth, SP = spatulate parempodia.

either subequal in length to head length (Fig. 3D) or significantly longer (Figs 3A-C, 13), either cylindrical or bilaterally compressed and outwardly arcuate (Figs 3B, 13); AII cylindrical, thin, elongate, longer than posterior width of pronotum (Figs 3, 6, 8, 13); AIII-IV extremely thin (Fig. 3D), cylindrical, elongate. Labrum subtriangular, shorter than first labial segment. Labium usually extending between meso and metacoxae, rarely elongate, reaching genital segments; LI longer than bucculae; LII often short. Pronotum transverse; often campanulate (Fig. 3A-C) with broad flattened collar, or in wing shortened species collar usually vestigial (Figs 6, 8), with pronotum ring-like and short; callosite region absent; posterior margin of

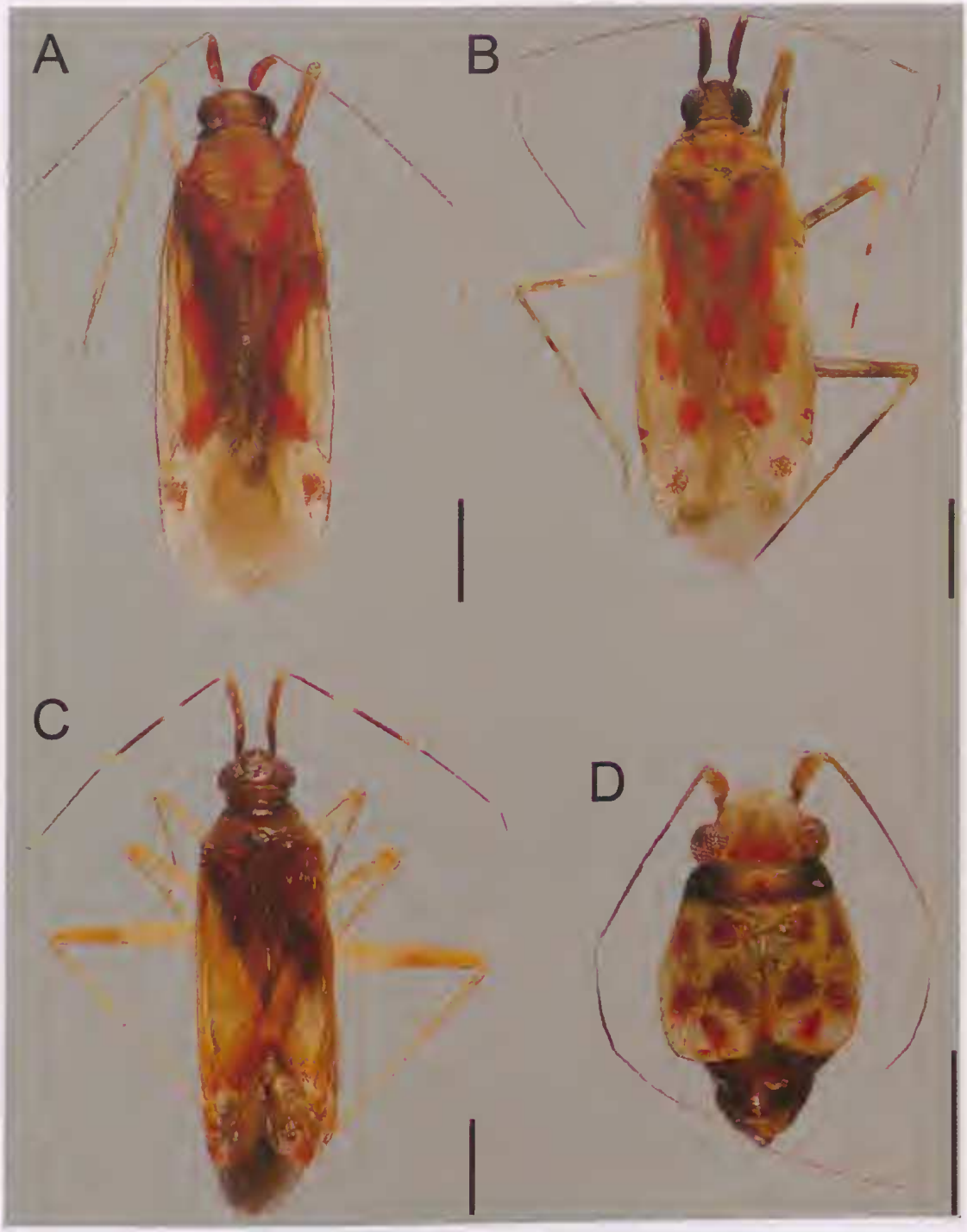


FIG. 3. Habitus photographs. A, *Vanniusoides asprokara*; B, *Vanniusoides melafrons*; C, *Vanniopsis rufescens*; D, *Austrovannius xepenehense*. Scale bar = 1.0mm.

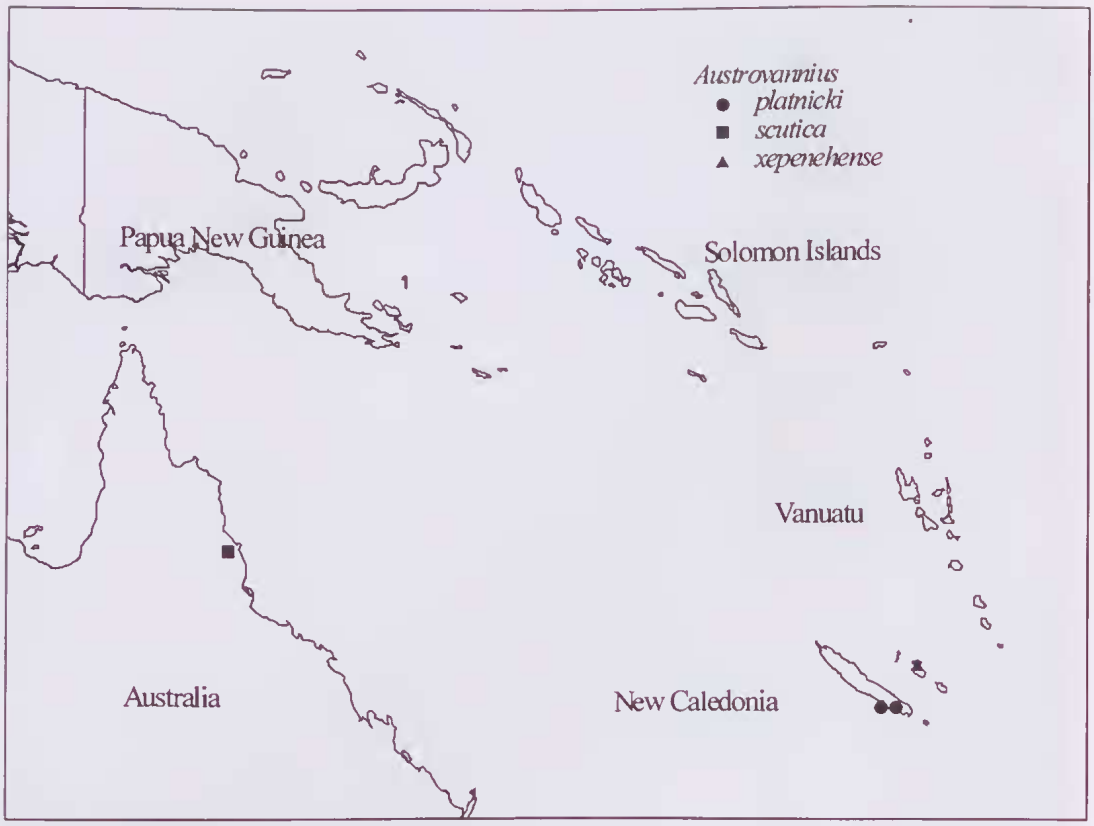


FIG. 4. Distribution map of *Austrovannius* species.

pronotum either bisinuate (Fig. 3A-C) or rectilinear (Figs 6, 8). Hemelytra: maeropterous species with wings weakly to strongly deflexed at cuneal fracture; cuncal fracture small to moderately large; cuneus elongate and usually narrow; two membrane cells (Fig. 3A,B). Procpisternum anteriorly directed (Figs 1A, 2B); proepimeron flat or medially depressed. Mesepimeron broadly fused with mesosternum (Fig. 2C); metathoracic spiracle exposed (Fig. 2C) or concealed (Fig. 1B); evaporative bodies on ventral angle of mesepimeron (Figs 1B-D, 2C). Metepisternum subrectangulate; well developed external efferent system of metathoracic glands, occupying about 1/3 of sclerite (Figs 1B, 2C); evaporative areas contiguous with mesepimeron; peritreme elliptical, raised posteriorly (Fig. 1C,D), positioned anteriorly or medially (Figs 1B, 2C) on sclerite, sometimes more broadly raised, spout-like. Legs elongate (Figs 3, 6, 8, 13). Metafemora greatly elongate, tapered distally (Fig. 3B, 13). Tarsi two-segmented (Figs 6, 8, 13). Pretarsi with weakly (Fig. 2F) to strongly arcuate (Fig. 1E) claws, with (Fig. 2F) or without (Fig. 1E) subapical teeth; spatulate parempoida; lacking pulvilli or pseudopulvilli (Fig. 1E). Male genitalia: pygophore conical (Figs 1G, 2E), sometimes with pygophoral processes; genital opening oval, dorsal (Fig. 1H) or terminal (Fig. 2E) in orientation; parameres roughly equivalent in size (Fig. 5A,B); sometimes only weakly asymmetrical; left paramere always largest, usually C-shaped (Fig. 5A) to weakly arcuate (Fig. 7A), with apex of shaft hooked (Fig. 5A), sometimes with basal (Figs 7A) or subapical (Fig. 9A) processes; aedeagus with membraneous endosoma (e.g. Figs 5C, 7C 14C, 15C), always with selerotised strap-like (often looped) basal sclerites; often with digitiform basal sclerites (Figs 5C, 7C, 9C), sometimes with multiple digitiform lobal sclerites (Figs 7C, 9C), less commonly with sclerotised, fan-like lobal sclerites (Figs 5C), with apical margin serrate; sceondary gonopore either undifferentiated (Figs 12C, 14C, 15C, 18C) or with prominent ring-like process with

dentate aperture (Figs 5C, 7C, 9C); ductus seminis short; phallotheca short to moderately large. Female genitalia: sclerotised rings (Figs 10A,C, 16A,C,E, 19A,C) relatively flattened or slightly folded and sometimes with small lobes on outside margin of ring; ventral labiate plate entire or separate, wider than width of ring(s); dorsal labiate plate reflexed mesially dorsal to rings or with scroll-like lateral margins; sometimes sclerotised rings and associated structures asymmetrical; posterior wall (Figs 10B,D, 16B,D,F, 19B,D) with inter-ramal sclerite entire or bilaterally separated; sometimes with one to three pairs of bilaterally separated inter-ramal lobes; dorsal lobe and lateral lobes absent.

DISTRIBUTION. The *Vannius* complex is circumtropical, with centres of endemism in Madagascar, island archipelagos of the south-west Pacific (Fiji, New Caledonia, Vanuatu), the wet tropics of northern Queensland, and the northern Neotropical region. All of the genera are restricted to a major zoogeographical region. Ten species and three genera (*Austrovannius*, *Vanniopsis* and *Vanniusoides*) are endemic to the Australian region (Figs 4, 11, 17).

REMARKS. Gorczyca (1997) erected a new tribe of Miridae, the Vanniini, for *Afrovannius* Gorczyca, *Paracylapus* Carvalho, *Vanniopsis* Poppius, *Vannius* Distant and *Vanniusoides* Carvalho & Lorenzato, which have spatulate parempodia and toothed claws. He removed these genera from the Cylapinae and placed them with the annectant taxon, *Palaucoris* Carvalho, a genus for which Carvalho (1956) established a subfamily with unspecified affinities. Gorczyca (1997) thereby established the following classification: Palaucorinae: Palaucorini (*Palaucoris*) and Vanniini (*Vannius* complex). In contrast, Schuh (1975) regarded the palaucorines as a subtribe of Bryocorinae, and as sister-group to the Eccritotarsina, within the tribe Eccritotarsini.

Gorczyca (1998) questioned his original arrangement, comparing the characters of the Vanniini with selected taxa of Cylapini (*Cylapomorpha migratoria* (Distant) and *Phylocylapus lutheri* Poppius). He recognised 'great similarities' of the body, antennae, tarsi and colour pattern. However, Gorczyca did not clearly restore the Vanniini within the Cylapinae, despite implicitly maintaining their tribal status. Moreover, he argued that there were alternative interpretations, based on potential homoplasy of the observed characters, including the parempodia.

We consider the arrangement of Gorczyca (1997) to be unsupported based on our reappraisal. Toothed-claws occur in Cylapinae, Psallopinae and some Isometopinae (Schuh, 1975, 1976; Schuh & Schwartz, 1984), and is therefore too general to be considered a synapomorphy of Palaucorini + Vanniini. Furthermore, the claw (with deeply notched subapex) of *Palaucoris*, is more elaborate than in the *Vannius* complex, and the putative homology is at best conjectural.

Spatulate parempodia as a synapomorphy for Palaucorinae *sensu* Gorczyca also needs re-analysis. Spatulate parempodia occur within other higher taxa, such as the Deraeocorinae: Termatophylini (e.g. *Arygrotelaeus* Reuter & Poppius — see Cassis, 1995: figs 89, 95), and Phylinae (e.g. *Arafuramiris* Schuh — see Schuh, 1984: fig. 670) but these latter exemplars are not indicative of suprageneric relationships. However, the presence of spatulate parempodia in Palaucorinae *sensu* Gorczyca does appear to be invariant and their homology cannot be falsified at present.

Gorczyca (1997) listed a number of characters additional to the aforementioned pretarsal characters, as a basis for his concept of the Palaucorinae. These include the vertical head and the short labium. The former character occurs in many mirid groups, but most significantly in many of the taxa placed within the Cylapini *sensu* Carvalho. This suggests that the *Vannius* complex is related to taxa within the Cylapini. Moreover, Schuh (1976) showed that Bryocorinae: Eccritotarsini, including *Palaucoris*, possess a vertical head.

The length of the labium has limited phylogenetic value. In most Miridae the labium extends between the middle and hind coxae, and are distinct in comparison to the elongate condition found in most Cylapinae *sensu* Carvalho. Gorczyca (1997) reported that the Palaucorini and Vanniini possess a short labium. Our observations suggest that the length of the labium varies considerably in the *Vannius* complex, varying from the mesocoxae to the gential segments. In contrast, the labium in *Palaucoris* does not extend beyond the middle of the mesocoxae.

In summary, we believe that there is not ample support for the conception of the Palaucorinae as a subfamily comprising *Palaucoris* and the *Vannius* complex. There is considerable homoplasy exhibited in the characters described by Gorczyca (1997, 1998). Pending a phylogenetic

analysis of a larger sample of cylapine taxa we propose that the *Vannius* complex be maintained in the Cylapinae as *incertae sedis* and that its relationship with *Palaucoris* be rejected.

## CHECKLIST OF *VANNIUS* COMPLEX

| | |
|---|---|
| *Austrovannius* gen. nov. | |
| *plainicki* sp. nov. | New Caledonia |
| *scutica* sp. nov. | Australia (north Qld) |
| *xepenehense* sp. nov. | New Caledonia |
| *Afrovannius* Gorczyca, 1997 | |
| *annulicornis* (Poppius, 1909) | Madagascar |
| *halinae* Gorczyca, 1997 | Sierra Leone |
| *mahensis* (Distant, 1913) | Seychelles |
| *schmitzi* (Gorczyca, 1996) | Madagascar |
| *Paracylapus* Carvalho, 1952 | |
| *insularis* Carvalho, 1952 | Madagascar |
| *lestoni* (Gorczyca, 1996) | Ghana |
| *Vanniopsis* Poppius, 1909 | |
| *crobylos* sp. nov. | Vanuatu |
| *howense* sp. nov. | Australia (Lord Howe I) |
| *rufescens* Poppius, 1909 | New Caledonia, Vanuatu |
| *Vannius* Distant, 1883 | |
| *crassicornis* Poppius, 1909 | Bolivia |
| *oculatus* Carvalho, 1955 | Costa Rica |
| *podager* Bergroth, 1922 | Brazil |
| *rubrovittatus* Distant, 1883 | Colombia, Guatemala, Panama |
| *Vanniusoides* Carvalho & Lorenzato, 1978 | |
| *asprokara* sp. nov. | Fiji |
| *brevis* (Poppius, 1909) | New Guinea |
| *clypeatus* Gorczyca & Konstantinov, 2001 | Solomon Islands |
| *melafrons* sp. nov. | Australia (north Qld) |

## KEY TO THE GENERA OF THE *VANNIUS* COMPLEX

1. Labium extending to genital segments; males with longitudinal ridge on ventral surface of pygophore (Fig. 1G) . . . . . *Austrovannius* gen. nov.
   Labium extending at most to fourth abdominal segment; males without ventral ridge on ventral surface of pygophore. . . . . 2
2. Head with longitudinal shallow sulcus (Fig. 2A) . . . . 3
   Head entire, without sulcus (Fig. 6) . . . . . 4
3. AI significantly longer than head (Figs 3A,B, 13) . . . . . *Vanniopsis*
   AI equal to or shorter than length of head (Figs 3D, 6, 8) . . . . . *Vannius*
4. Two subapical teeth on tarsal claws; peritreme of external efferent system of metathoracic glands medially oriented on metepisternum . . . . . *Paracylapus*
   One subapical tooth on each tarsal claw (Fig. 2F); peritreme of external efferent system of metathoracic glands anteriorly oriented on metepisternum . . . . . 5
5. Dorsum with distinct red-orange markings and narrow black markings on head, clavus and hemelytra; femora enlarged basally . . . . . *Afrovannius*
   Dorsum with distinct red-orange markings only; femora narrow . . . . . *Vanniusoides*

### **Austrovannius** gen. nov.
(Figs 1, 3D, 4-10)

ETYMOLOGY. For its restriction to the Australian region and its membership of the *Vannius* complex.

TYPE SPECIES. *Austrovannius scutica* sp. nov., by original designation.

DIAGNOSIS. Staphylinoid (Figs 6, 8); pronotal collar almost obsolete, at most as an impressed line (Figs 6, 8); labium reaching between abdominal sternum VII and genital segments; pronotum reduced and flattened (Figs 6, 8); claws strongly arcuate (Fig. 1E); subapical teeth absent (Fig. 1E); pygophore with longitudinal medial ridge on ventral surface (Fig. 1G); endosoma with basal and lobal sclerites (Figs 5C, 7C, 9C); sclerotised rings (Fig. 10A,C) asymmetrical, large, and with marginal processes; and, posterior wall (Fig. 10B,D) with inter-ramal lobes.

DESCRIPTION. *Colouration*. Body reddish to brown, sometimes with disrupted red markings on dorsum (Figs 3D, 8), lateral aspects of head and thoracic pleura. Metafemora sometimes with red banding. Abdominal venter stramineous to red-fuscous.

*Vestiture*. Body with sparse to moderate density of soft to stiff (bristle-like) semi-erect to decumbent, simple setae (Fig. 3D).

*Texture*. Body smooth.

*Structure*. Small; staphylinoid (Figs 3D, 6, 8); ovoid. Head: vertex flat to weakly convex (Fig. 1A), sometimes with submedial weak depressions. Antennae thread-like, elongate, much longer than body, at least 1.5× longer (Fig. 3D); AI equal to head length (Figs 6, 8), weakly expanded; AII elongate (Figs 6, 8), cylindrical, narrow, a little broader than AIII-AIV; AIII-AIV elongate, very narrow. Labium elongate, extending between abdominal sterna VII and genital segments. Pronotum (Figs 6, 8) transverse, subrectangular, ring-like, small, flat; collar vestigial, at most as thin crease; remainder of pronotum uniform, not subdivided into callosite region and disc; posterior margin rectilinear. Mesoscutum not visible (Figs 6, 8). Scutellum triangular, transverse, small, shorter than pronotum, flat (Figs 6, 8). Proepimeron weakly depressed medially (Fig. 1A). Mesepimeron: metathoracic spiracle (Fig. 1B-D) not exposed; ventral angle of mesepimeron with evaporative bodies. External efferent system of metathoracic glands (Fig. 1B-D) occupying a little more than a third of metepisternum; peritreme elliptical, moderately tumid and raised, positioned

medially on metepisternum, not reaching lateral margin of evaporative area. Metafemora greatly elongate, tapered distally. Pretarsal claws (Fig. 1E,F) strongly arcuate, subapical teeth absent. Male genitalia: pygophore subconical (Fig. 1G,H), with longitudinal medial ridge on ventral surface; genital opening large, ovoid, dorsally oriented; sometimes with flange-like processes dorsoanteriorly to paramere insertions; parameres simple; left paramere (Figs 5A, 7A, 9A) C-shaped to subtriangular, usually elongate, sometimes with basal or subapical process; right paramere (Figs 5B, 7B, 9B) either short or elongate; phallotheca large, subconical; aedeagus (Figs 5C, 7C, 9C) with membraneous endosoma, most often with multiple lobal sclerites, rarely without lobal sclerites, most lobal sclerites digitiform, tapered apically, often with fan-like lobal sclerites, with apices serrate; strap-like basal sclerites present, often with additional digitiform processes; secondary gonopore large, sclerotised, with dentate aperture. Female genitalia: sclerotised rings (Fig. 10A,C) asymmetrical, moderately large to large, folded with pointed processes on lateral margins; ventral labiate plate entire, convoluted; dorsal labiate plate well-sclerotised not as wide laterally as ventral labiate plate; posterior wall (Fig. 10B,D) with inter-ramal sclerite entire and anterior surface with one to three pairs of bilateral inter-ramal lobes.

DISTRIBUTION AND HABITAT. *Austrovannius* is restricted to the southwest Pacific (Fig. 4), and is known from New Caledonia, the Loyalty Islands, and tropical Queensland (Bellenden Ker Range). The three described species are known from leaf litter in rainforests.

REMARKS. *Austrovannius* is the most distinctive genus of the *Vannius* complex, and has a number of notable autapomorphies, including, the short ring-like pronotum (collar vestigial) (Figs 6, 8), ridge-like ventral midline of the pygophore (Fig. 1G), the elongate labium (almost or reaching genital segments), the strongly arcuate tarsal claws, and the elaborate male and female genitalia. The species are all very small, less than 2mm in length, and have an ovoid body, often with disruptive colouration (Fig. 3D). The male genitalia are the most intricate in the *Vannius* complex with the endosoma bearing both basal and lobal sclerites (Figs 5C, 7C, 9C). In addition, the secondary gonopore is strongly sclerotised with a dentate aperture.

As mentioned above the genus contains many undescribed species and are the subject of another paper.

## KEY TO THE SPECIES OF *AUSTROVANNIUS*

1. Pronotum and forewings usually concolorous (Fig. 6), either brown or reddish . . . . . 2
   Pronotum and forewings stramineous with patterned red markings (Figs 3D, 8) . . . . . 3
2. Pronotum and forewings brown; left paramere (Fig. 5A), without basal process apex hooked; endosoma (Fig. 5C) with two sickle-shaped spiculi attached below secondary gonopore, and two apical fan-like lobal sclerites; New Caledonia . . . . . *platnicki*
   Pronotum and forewings stramineous-red; left paramere (Fig. 7A) with basal process, apex not hooked; endosoma (Fig. 7C) without sickle-shaped spiculi or fan-like lobal sclerites; North Queensland . . . *scutica*
3. Metafemora mostly brown with apex stramineous; endosoma (Fig. 5C) with two basal spiculi, without lobal sclerites; New Caledonia . . . . . *platnicki*
   Metafemora mostly stramineous with submedial and subapical red bands (Figs 3D, 8); endosoma (Fig. 9C) with digitiform and fan-like lobal sclerites, without basal spiculi; Loyalty Islands . . . . . *xepenehense*

### **Austrovannius platnicki** sp. nov.
(Figs 4, 5)

ETYMOLOGY. In honour of Dr Norman Platnick, who was one of the collectors of the type series.

MATERIAL. NEW CALEDONIA. Holotype, ♂, Mount Koghis, 22°11'S 166°31'E, 500m, 23-30 May 1987, R Raven and N Platnick, rainforest pitfalls (MNHP); Paratypes: 6♂♂, same data as holotype (AM, QM); 1♂2♀♀ Mount Koghis, 22°11'S 166°01'E, 500m, 22 November 2000, GB Monteith rainforest sieved litter (QM); 1♂3♀♀, Mount Koghis, 22°11'S 166°01'E, 500m, 22 November 2000, GB Monteith, pyrethrum trunks and logs, 9931 (QM).

DIAGNOSIS. Pronotum and forewings most often stramineous-brown; labium uniformly stramineous, reaching abdominal sternum VII; thoracic pleura dark brown; metafemora dark brown; tibiae stramineous; left paramere (Fig. 5A) sickle-shaped, without basal process, shaft broadly and evenly arcuate; endosoma (Fig. 5C) without lobal sclerities, with pair of bifureate basal sclerites, two basal arcuate spiculi and two apical fan-like plates.

DESCRIPTION. *Colouration*. Body mostly stramineous brown, rarely with red markings on dorsum. Head stramineous to yellow-brown; vertex with an obscure brown (rarely red) subtriangular marking; mandibular and maxillary plates, bucculae, genae and gular mostly stramineous, rarely mostly red, with fuscous

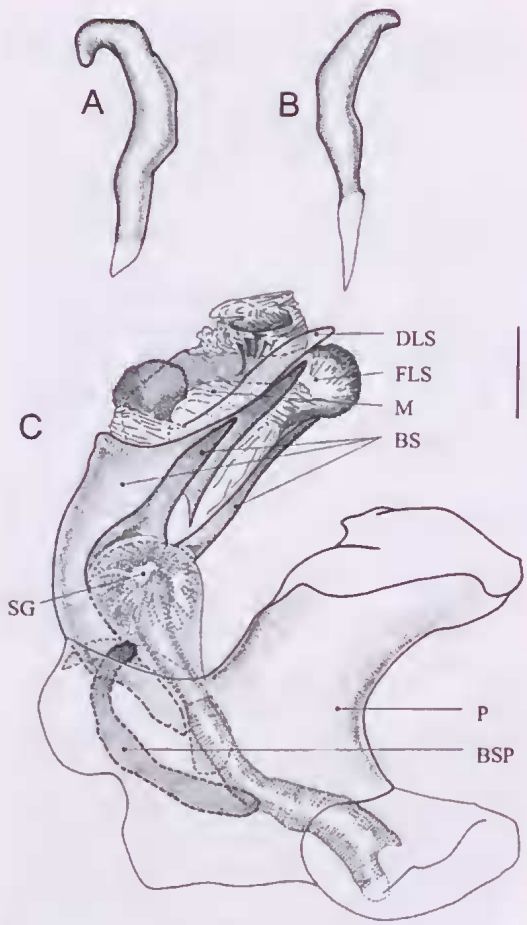


FIG. 5. *Austrovannius platnicki*. A, left paramere; B, right paramere; C, acdeagus. BS = basal sclerites, BSP = basal spiculum, DLS = digitiform lobal sclerite, FLS = fan-like lobal sclerite, M = membaneous sac, P = phallotheca, SG = secondary gonopore. Scale bar = 0.10mm.

highlighting. Labium stramincous to stramineous-brown. Antennae mostly stramincous, AII with an apical whitish annulation. Pronotum stramineous-brown, laterally darker, sometimes laterally red. Thoracic pleura stramineous-brown, sometimes with ventral margin of propleura paler, rarely more uniformly red with fuscous highlighting. Scutellum stramineous, rarely anterior margin with red tinge. Forewings mostly stramineous-brown, rarely with disruptive reddish markings. Legs mostly stramineous-brown; coxae brown; fore and mesofemora stramineous; hind femora darker brown, with apices stramineous; tibiae and tarsi stramineous. Abdomen mostly brown, sometimes pygophore paler ventrally.

*Structure.* Labium reaching abdominal sternum VII. Male genitalia: left paramere (Fig. 5A) sickle-shaped, without basal process, shaft broadly and evenly arcuate; right paramere (Fig. 5B) arcuate, subequal in size to left paramere, apex weakly angulate; endosoma (Fig. 5C) with two major membraneous lobes, two basal arcuate spiculi, one with apex acute, other with apex serrate, secondary gonopore sclerotised, with aperture dentate, with pair of bifurcate digitiform basal sclerites, with two apical fan-like lobal sclerites, without digitiform lobal sclerites. Female genitalia not examined.

*Measurements.* 3♂♂ BL 1.49-1.92, HW 0.61-0.62, IOD 0.28-0.30, HL 0.34-0.37, PL 0.15-0.17, PW 0.64-0.66, AII 0.98-1.06, LL 0.87-0.96; 1♀ BL 1.88, HW 0.63, IOD 0.30, HL 0.36, PL 0.17, PW 0.66, AII 1.01, LL 1.10.

DISTRIBUTION AND HABITAT. Mid-altitude rainforest in southern New Caledonia, from a single location (Mt Koghis) (Fig. 4). The species is epigaeic, with most specimens collected in pitfall traps or from sieved litter. A series was collected by pyrethrum fogging, from trunks and logs.

REMARKS. *Austrovannius platnicki* is unlike the other species of the genus, in lacking digitiform lobal sclerites. The endosoma (Fig. 5C) is complex however, in possessing bifurcate basal sclerites, apical fan-like lobal sclerites and basal spiculi. The genitalia are most like those of *A. xepenehense*, in possessing fan-like lobal sclerites and basal processes, but the latter is differentiated by having lobal sclerites (cf. Figs 5C and 9C). The parameres of these species are also alike, with both having C-shaped parameres (cf. Figs 5A,B and 9A,B).

These above species are often distinguished externally by colour pattern differences, with most specimens of *A. platnicki* uniformly brown, and *A. xepenehense* with red markings on the dorsum. A single series of *A. platnicki* (reference number 9931) has red markings, similar to those found in *A. xepenehense*, but the male genitalia are clearly conspecific with the other Mt Koghis specimens of *A. platnicki*. Precedence is given to the value of the male genitalia in species level decision-making, because of the complexity of the structures of the endosoma. The species description of *A. platnicki* is primarily based on the 'Raven and Platnick' material because there

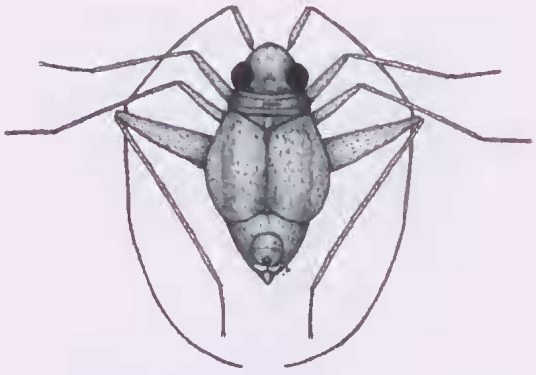

FIG. 6. Habitus of *Austrovannius scutica*.

are more specimens and they are in superior condition. The three series were collected at different periods (May and November), which suggests that this species is multivoltine and colour polymorphism may be attributable to generational factors. The female specimens were not examined because there is some doubt about their conspecificity.

**Austrovannius scutica** sp. nov.
(Figs 1D-H, 4, 6, 7, 10A,B)

ETYMOLOGY. Latin *scutica*, referring to the extremely long whip-like antennae.

MATERIAL. QUEENSLAND. Holotype, ♂, Bellenden Ker Range, 1km S of Cable Tower 6, 17°9'36"S 145°31'48"E, 500m, 17-24 October 1981, 500 metres, Earthwateh and Queensland Museum Survey, rainforest sieved litter, QM Berlesate No. 319, GB Monteith (QM; Registration no. QM T108614). Paratypes: 2♂, same data as holotype, QM Berlesate Nos 315 and 320 (QM); 2♂♂, Bellenden Ker Range, Cableway base station, [17°9'36"S 145°32'24"E], 100m, 17 October-9 November 1981, Earthwateh and Queensland Museum survey, rainforest pitfall trap, GB Monteith (AM; QM).

DIAGNOSIS. This species is distinguished by the following combination of characters: pronotum and forewings red; first labial segment red, LII-IV stramineous; thoracic pleura mostly uniformly red, sometimes more reddish-fuscous; left paramere (Figs 7A) subtriangular, with basal process, apex hooked; right paramere (Fig. 7B) subtriangular with apex hooked; endosoma (Fig. 7C) with seven lobal sclerites; and, posterior wall (Fig. 10B) with one pair of widely separated dorsal inter-ramal lobes.

DESCRIPTION. *Colouration*. Body (Fig. 6) mostly red to reddish-brown with stramineous patches on head, ventral surface of body mostly

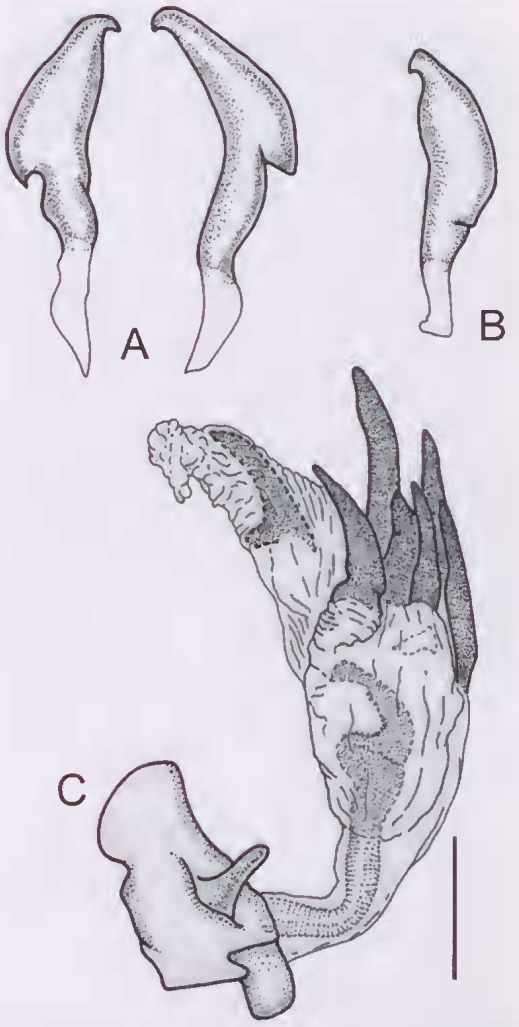


FIG. 7. *Austrovannius scutica*. A, left paramere, lateral view; B, left paramere, mesial view; C, right paramere; D, aedeagus. Scale bar = 0.10mm.

red, sometimes with stramineous or fuscous highlighting. Head stramineous to yellow-brown; posterior margin of vertex occasionally more enbrowned; mandibular plate yellow-brown to fuscous-red; maxillary plate, bucculae, genae and gular most often red. Labium: LI red; LII-IV stramineous. Antennae mostly stramineous; AI sometimes with small red spots basally; AII-AIV sometimes weakly enbrowned. Pronotum: red to reddish-fuscous. Thoracic pleura red or reddish-fuscous. Scutellum stramineous-red to stramineous-fuscous. Forewings mostly stramineous-red, rarely reddish-fuscous. Legs

mostly stramineous; coxae stramineous-red; fore and mesofemora stramineous; metafemora red-brown with stramineous annulations on distal third and apex; tibiae and tarsi stramineous. Abdomen mostly red; male pygophore sometimes stramineous-red ventrally.

*Structure*. Habitus (Fig. 6). Labium reaching genital segments. External efferent system of metathoracic glands (Fig. 1D). Pretarsus (Fig. 1E,F). Male genitalia: pygophore (Fig. 1G,H); left paramere (Fig. 7A) small, subtriangular, with acute hook-like basal process, apex of shaft hooked; right paramere (Fig. 7B) small, elongate, also with apical and basal hook-like processes; endosoma (Fig. 7C) enlarged, with multilobed membranous sac, one lobe of sac with four elongate lobal sclerites, without basal arcuate spiculi or apical fan-like lobal sclerites. Female genitalia: (Fig. 10A,B) sclerotised rings and labiate plates (Fig. 10A) moderately large, rings attenuated mesially, widely separated, folded, and adhering ventral plate anteriorly; ventral labiate plate entire, anterior margin thickened; dorsal labiate plate obscure; inter-ramal sclerite of posterior wall (Fig. 10B) with ventral margin attenuated, flanking minutely spinose mesial region, with two widely separated, bilaterally sculpted inter-ramal lobes dorsally.

*Measurements*. 5♂ ♂ BL 1.20-1.40, HW 0.55-0.56, IOD 0.24-0.27, HL 0.27-0.34, PL 0.15-0.18, PW 0.54-0.61, AII 1.18-1.29, LL 0.92-1.10; 1♀ BL 1.58, HW 0.57, IOD 0.26, HL 0.37, PL 0.16, PW 0.63, AII 1.15, LL 1.16.

DISTRIBUTION AND HABITAT. Mid-altitude rainforest in the wet tropics of Queensland (Bellenden Ker Range) (Fig. 4). Epigaeic, with specimens collected either by sieving litter, or in pitfall and flight intercept traps. A single specimen was collected by pyrethrum fogging.

REMARKS. *Austrovannius scutica* is distinguished from *A. platnicki* and *A. xepenehense* by differences in the shape of the parameres (cf. Figs 5A,B, 7A,B and 9A,B) and structure and size of the endosoma (cf. Figs 5C and 9C). Unlike its congeners, *A. scutica*, has a distinct left paramere (Figs 7A); with a basal process and the shaft not broadly arcuate. The endosoma (Fig. 7C) of the latter species is diagnostic, and is small, lacks arcuate spiculi and apical fan-like lobal sclerites, and has seven elongate digitform lobal sclerites. *A. scutica* is also more uniformly red in colour.

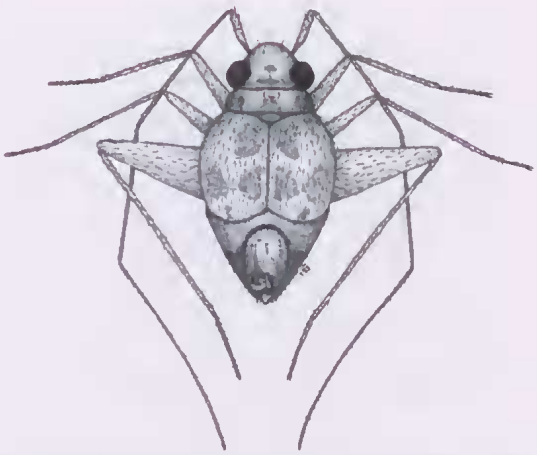

FIG. 8. Habitus of *Austrovannius xepenehense*.

**Austrovannius xepenchensc** sp. nov.
(Figs 3D, 4, 8, 9, 10C,D)

ETYMOLOGY. Types from Xepenehe.

MATERIAL. LOYALTY ISLANDS: Holotype, ♂, Lifou Island, Xepenehe, 20°47'S 167°11'E, 20m, 6 December 2000, GB Monteith, rainforest sieved litter (MNHP). Paratypes: 4♂ ♂ 1♀, same data as holotype (AM; QM).

DIAGNOSIS. Dorsum stramineous with disruptive red markings (Figs 3D, 8); first antennal segment with reddish highlighting; propleura with two red transverse bands; forewings with ten red markings; metafemora stramineous with submedial and subapical red bands; left paramere (Fig. 9A) with subapical triangular process; endosoma (Fig. 9C) with four digitiform and two fan-like lobal sclerites, and basal sclerites, without basal spiculi; sclerotised rings (Fig. 10C) large, folded, with conspicuous lateral lobes; posterior wall (Fig. 10D) with three bilaterally paired inter-ramal lobes on anterior surface of complete inter-ramal sclerite .

DESCRIPTION. *Colouration*. Body yellow-brown to stramineous, with red markings on dorsum (Fig. 3D, 8). Head mostly stramineous; vertex with reddish markings; frons and genae with red markings, often bounding antennifers; postclypeus with reddish tinge; genae posteriad of maxillary plate with red spot. Labrum mostly stramineous, sometimes with reddish highlighting. Labium: LI mostly red, remainder stramineous to stramineous-brown, with apex of LIV with fuscous highlighting. Antennae: AI stramineous with reddish highlighting (Fig. 3D);

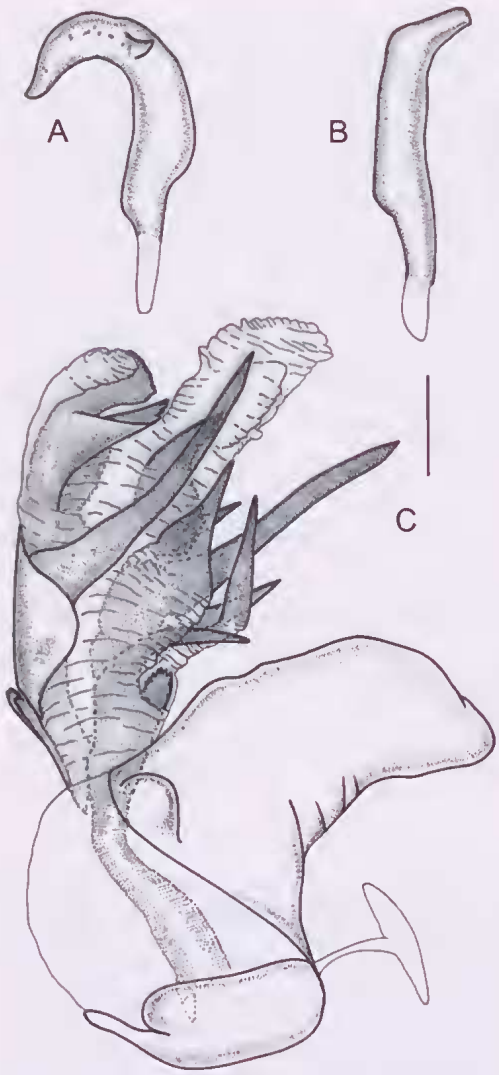


FIG. 9. *Austrovannius xepenehense*. A, left paramere; B, right paramere; C, aedeagus. Scale bar = 0.10mm.

AII-AIV dark brown, apex of AII with whitish apical band. Pronotum mostly stramineous with reddish markings (Fig. 3D); collar with medial red transverse marking; disc laterally and mediposteriorly with red markings. Scutellum most often stramineous, sometimes with reddish highlighting. Forewings with 10 red markings (Fig. 3D); each wing with pair sub-basally, pair submedially, single spot apically. Proepisternum fuscous-red; proepimeron with two transverse bands of fuscous-red. External efferent system of metathoracic glands stramineous, remainder of metepisternum red to fuscous-red. Legs mostly

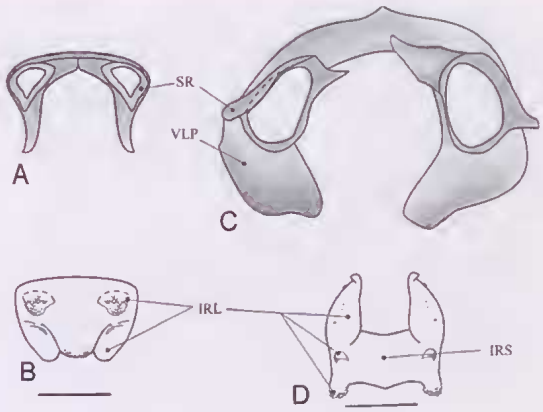


FIG. 10. Female genitalia. *Austrovannius scutica* A, selerotised rings; B, posterior wall; *Austrovannius xepenehense*: C, selerotised rings; D, posterior wall. IRL = inter-ramal lobe, IRS = inter-ramal selerite, SR = selerotised ring, VLP = ventral labiate plate. Scale bar = 0.25mm.

stramineous to light-brown, sometimes with red highlighting; metafemora with submedial and subapical red bands (Fig. 3D); tibiae often stramineous-red.

*Structure*. Habitus (Figs 3D, 8). Labium reaching abdominal sternum VII. Male genitalia: pygophore with small flange-like processes anterodorsally to paramere insertions; left paramere (Fig. 9A) C-shaped, with subapical triangular process, shaft evenly arcuate with apex hook-like; right paramere (Fig. 9B) sublinear with apex angulate; endosoma (Fig. 9C) bilobed, each subtended by basal processes, one a multifurcate process with four arms, the other with an elongate digitform process; four elongate digitform and one fan-like (with serrated apex) lobal selerites. Female genitalia: selerotised rings (Fig. 10C) large, folded, narrowly separated, attenuated mesially, anterior margin asymmetrically convoluted and attached to dorsal labiate plate; posterior wall (Fig. 10C) with three bilaterally paired inter-ramal lobes on anterior surface of complete inter-ramal selerite, dorsal pair pointed, prominently projecting above dorsal margin of inter-ramal selerite equal to height of selerite, middle pair pointed, short, ventral pair blunt with sculptured surface.

*Measurements*. 4♂♂ BL 1.35-1.50, HW 0.58-0.60, IOD 0.29-0.30, HL 0.31-0.32, PL 0.15-0.17, PW 0.63-0.65, AII 1.10-1.20, LL 0.98-1.03; 1♀ BL 1.75, HW 0.65, IOD 0.30, HL 0.33, PL 0.19, PW 0.68, AII 1.00, LL 1.05.

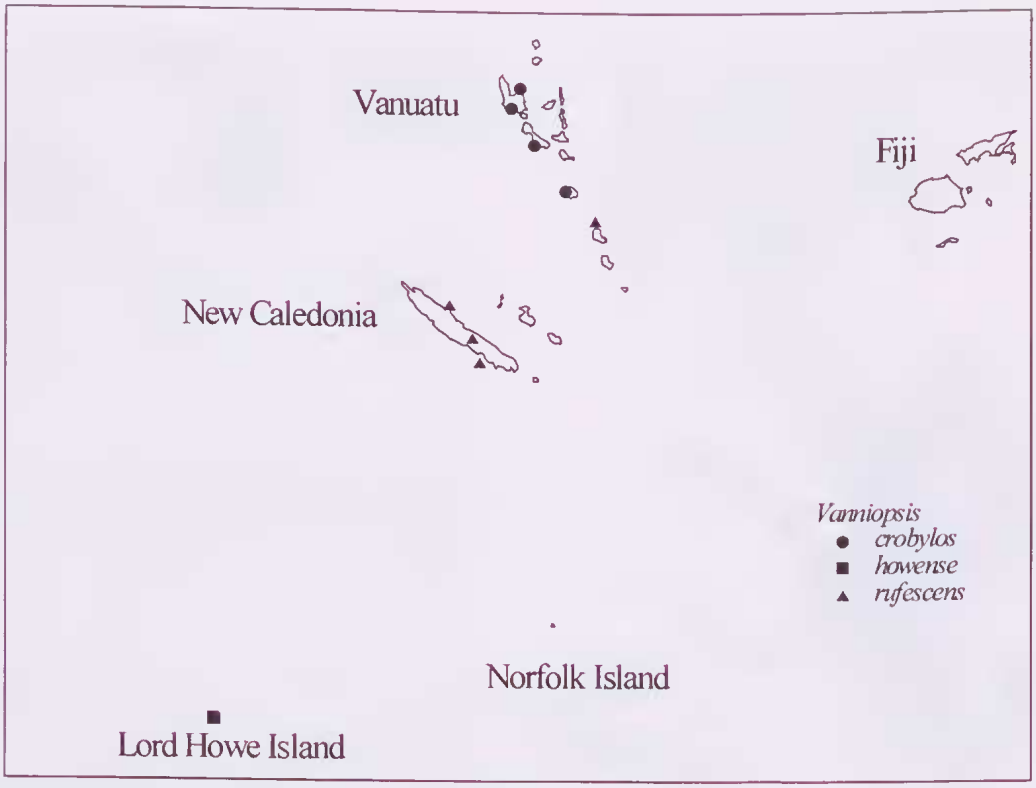


FIG. 11. Distribution map of *Vanniopsis*.

DISTRIBUTION AND HABITAT. From two lowland rainforest sites on Lifou Island (Loyalty Islands) (Fig. 4), amongst leaf litter, and on tree trunks and fallen logs. These specimens have been collected near sea level.

REMARKS. The species is noteworthy for its disruptive colouration (Fig. 3D) and distinctive male aedeagus (Fig. 9C). The endosoma resembles *A. platnicki* in possessing prominent basal processes and apical fan-like lobal sclerites (cf. Figs 5C and 9C). It differs from it by having digitiform lobal sclerites, this latter condition also occuring in *A. scutica*. The left paramere of *A. xepenehense* and *A. platnicki* are alike in being C-shaped, but the former species has a small subapical triangular process (cf. Figs 5A and 9A).

## Vanniopsis Poppius, 1909

*Vanniopsis* Poppius, 1909: 17 (sp. nov.); Carvalho, 1957: 33 (catalogue); Schuh, 1995: 39 (catalogue); Gorczyca, 1997: 519, 540-542, figs 8 and 16 (description).

TYPE SPECIES. *Vanniopsis rufescens* Poppius, 1909, by original designation.

DIAGNOSIS. Head subtriangular (Figs 2A, 13); frons prominent (extending beyond eyes); AI longer than head (Figs 3C, 13); AI compressed and arcuate, much longer than head, with dense distribution of bristle-like setae; AII banded (Fig. 3C); pronotal collar flat and broad (Fig. 3C, 13); tarsal claws weakly arcuate (Fig. 2F); subapical teeth present (Fig. 2F); endosoma (Figs 12C, 14C, 15C) membraneous, usually with paired looped strap-like basal sclerites, secondary gonopore undifferentiated; phallotheca short; parameres strongly asymmetrical; left paramere (Figs 12A, 14A, 15A) large, C-shaped, tapered apically; right paramere (Fig. 16A,C,E) smaller than left paramere, sublinear, apex of shaft tapered; sclerotised rings (Figs 12A, 14A, 15A) widely separated, ovoid, flattened mesially; and, posterior wall (Fig. 16B,D,F) simple, with small, paired inter-ramal sclerites, without inter-ramal lobes.

DESCRIPTION. *Colouration*. Head and pronotum mostly brown, with forewings either reddish, or stramineous to brown with reddish to orange-red markings (Figs 3C, 13). Head often

brown, with posterior margins of vertex with reddish markings; frons often pale yellow to light brown; clypeus either pale yellow to red; bucculae, mandibular and maxillary plates, and genae either pale yellow or red. Antennae: AI either mostly stramineous with reddish markings or red; AII banded (Fig. 3C), mostly brown with basal, medial and apical yellow bands; AIII mostly brown with apical yellow band; AIV brown. Labium mostly stramineous to stramineous-orange, with LI sometimes with red highlighting, LIV sometimes with fuscous highlighting. Thoracic pleura mostly red, sometimes propleura more brown. Legs mostly stramineous; metafemora with subapical reddish marking. Pronotum mostly brown, sometimes with longitudinal medial stramineous line. Scutellum mostly brown, sometimes apex stramineous. Forewings (Fig. 3C) either mostly red to orange-red with stramineous to hyaline regions on corium or in staphylinoid species brown with four reddish markings; cuneus red or orange-red with apex red; membrane fumose. Abdominal venter red to orange-red.

*Vestiture*. Dorsum usually with short dark semi-erect, bristle-like setae. Frons sometimes with dense distribution of elongate semi-erect setae (Figs 3C, 13).

*Texture*. Mostly smooth, with forewings often weakly rugose.

*Structure*. Macropterous (Fig. 3C) or staphylinoid (Fig. 13); elongate to elongate-ovoid. Head: (Fig. 2A,B) vertex weakly convex to flat, with shallow longitudinal sulcus. Antennae elongate, thread-like, subequal (Fig. 3C) to or longer than body (Fig. 13); AI (Figs 3C, 13) thickened, bilaterally compressed, arcuate, longer than head length; AI longer than AIII. Labium extending to metacoxae. Pronotum transverse; campanulate or rectangulate; collar broad, flat. Mesoscutum exposed or concealed. Scutellum flat to weakly convex, subequal in length to pronotum. Hemelytra: corium broad, moderately convex; cuneus elongate. Thoracic pleura: (Fig. 2C) procpimeron flat to weakly depressed medially; metathoracic spiracle exposed, bounded by evaporative bodies; external efferent system of metathoracic glands moderately developed, occupying about 1/3rd of segment; peritreme tumid, orientated anteriorly to medially, not reaching dorsal margin of evaporative area, sometimes peritreme strongly raised and tumid, and external efferent system spout-like. Legs: metafemur elongate (Fig. 3C) and tapered distally; tarsal claws weakly arcuate; claws with subapical teeth. Male genitalia: left paramere (Figs 12A, 14A, 15A) large, C-shaped, tapered apically; right paramere (Figs 14B, 15B) smaller, sublinear, apex of shaft tapered; endosoma (Figs 12C, 14C, 15C) membraneous, with or without selerotised spinose fields, without lobal selerites, usually with paired looped strap-like basal selerites supporting membrane; secondary gonopore undifferentiated; phallotheca short. Female genitalia: selerotised rings (Figs 16A,C,E) weakly differentiated, widely separated, ovoid, flattened mesially; posterior wall (Figs 16B,D,F) simple, with small, paired separated narrow, lunate-shaped inter-ramal selerites, without inter-ramal lobes.

DISTRIBUTION. New Caledonia, Vanuatu and Lord Howe Island (NSW, Australia) (Fig. 11).

REMARKS. *Vanniopsis* is best differentiated by its first antennal segment and the aedeagus. The most distinctive feature of this genus is the arcuate, elongate (much longer than head) and bilaterally compressed first antennal segment (Figs 3C, 13), which also has dense bristle-like decumbent setae. In other taxa of the *Vannius* complex, the first antennal segment is a little larger or subequal to the head length, and is never compressed and arcuate, or has the vestiture described above.

There are superficial reasons for erecting a new genus for *V. howense*, because of its morphological distinctiveness; namely, the staphylinoid body and correlated reductions of the pronotum and scutellum, as well as the elongate antennae (Fig. 13). However, this species is clearly congeneric with its macropterous relatives, based on the aforementioned characters (first antennal segment and aedeagus).

## KEY TO THE SPECIES OF *VANNIOPSIS*

1. Macropterous (Fig. 3C); antennae subequal in length to the body; genital opening of male pygophore dorsal in orientation . . . . . 2

   Staphylinoid (Figs 2D, 13); antennae significantly longer than body; genital opening of male pygophore terminal in orientation (Fig. 2E); Lord Howe Island . . *howense*

2. Frons densely setate; clypeus, mandibular and maxillary plates stramineous; left paramere with subapical flange (Fig. 12A); three endosomal basal selerites, not looped (Fig. 12C); Vanuatu . . . . . *crobylos*

   Frons with sparse distribution of short decumbent setae; clypeus, mandibular and maxillary plates red; two pairs of looped endosomal basal selerites (Fig. 15C); New Caledonia, Vanuatu. . . . . *rufescens*

**Vanniopsis crobylos** sp. nov.
(Figs 11, 12, 16A,B)

ETYMOLOGY. Greek *krobylos*, referring to the tuft of hair on the head.

MATERIAL. VANUATU. Holotype, ♂ Malekula I[sland], South West Bay, [16°30'S 167°26'E], 300-350m, 2 October 1971, P. Cochereau Roy[al] Soc[iety] Percy Sladen Expedition, beating trees and sweeping grasses, forest (SAMA). Paratypes. ♀ same data as holotype (SAMA); 1♀, Espiritu Santo I[sland] (SW), below Namatasopa, [15°31'S 166°49'E], 250m, 1 September 1957, JL Gressitt (BPBM); 1♀, Efate I[sland] (NW), Limestone Plateau N of Maat, [17.6833°S 168.25°E], 100m, 19 August 1957, JL Gressitt (BPBM); 1♀, Santo I[sland], Iakabone [Iakobone] N of Port Olry, [15°01'S 167°03'E], 40-200m, 21-22 October 1981, JL Gressitt on *Elastostemma* [*sic*] (BPBM)

DIAGNOSIS. Macropterous; forewings rugose; frons densely hirsute; vertex with shallow longitudinal suleus; AI densely hirsute; collar present; AII banded; pronotum campanulate; posterior margin of pronotum bisinuate; mesoscutum exposed; peritreme raised, anteriorly oriented; endosoma with three basal sclerites, membrane reduced (Fig. 12C); and, left paramere (Fig. 12A) with subapical flange.

DESCRIPTION. *Colouration*. Body mostly pale red, with stramineous to stramineous-orange markings. Head brown, with posterior margin of vertex with red markings; clypeus, mandibular and maxillary plates, genae and gular stramineous, sometimes genae posterior to eyes red. Antennae: AI red, sometimes stramineous-red; AII banded, dark brown with medial and apical stramineous bands, with base minutely stramineous; AIII mostly brown with apical yellow band; AIV brown. Labium stramineous to yellow-orange, apex of IV sometimes enbrowned. Pronotum brown. Thoracic pleura red. Mesoscutum brown to red-brown. Scutellum stramineous-brown to orange-brown. Hemelytra mostly red, sometimes with exocorium broadly stramineous and translucent; cuneus mostly red, with apex and medial angle stramineous; membrane fumose, veins red. Legs mostly stramineous; coxae stramineous to red-stramineous; metafemora with subapical red marking. Abdomen mostly red; ovipositor stramineous to stramineous-brown.

*Texture*. Pronotum and hemelytra rugose.

*Vestiture*. Dorsum with moderate distribution of simple, fine, erect, elongate, dark setae. Frons with a dense tuft of elongate bristle-like setae.

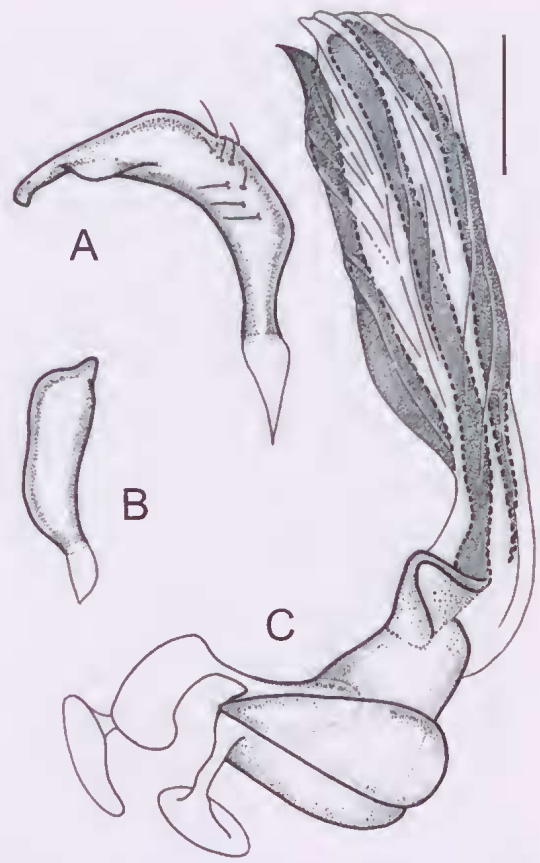


FIG. 12. *Vanniopsis crobylos*. A, left paramere; B, right paramere; C, aedeagus. Scale bar = 0.10mm.

*Structure*. Macropterous; elongate. Antennae subequal in length to body. Labium extending to apices of metacoxae. Pronotum campanulate; collar broad, anterior margin rectilinear; posterior margin bisinuate. Mesoscutum exposed. Scutellum as long as wide. External efferent system of metathoracic glands spout-like; peritreme anteriorly oriented. Hemelytra: strongly depressed at corial fracture; cuneus narrow and elongate. Male genitalia: pygophore subconical, genital opening large, ovoid, dorsally directed; left paramere (Fig. 12A) small, elongate, subrectangular, broadly expanded subapically, flangelike with hook-like apex; right paramere (Fig. 12B) small, subrectangular, lateral margin moderately emarginate, acute apical process coplanar with remainder of shaft; endosoma (Fig. 12C) with three strap-like basal sclerites supporting thin membranous sac, secondary gonopore undifferentiated. Female genitalia: sclerotised rings (Fig. 16A) moderately

small, semi-elliptical, mesial margin flattened; ventral labiate plate separated, convex anteriorly, flattened mesially; dorsal labiate plate scroll-like laterally; posterior wall (Fig. 16B) with bilaterally paired, thin inter-ramal sclerites on dorsal margin.

*Measurements.* 1♂ BL 3.82, HW 0.68, IOD 0.26, HL 0.38, PL 0.50, PW 0.95; 4♀♀ BL 3.74-4.01, HW 0.62-0.66, IOD 0.24-0.26, HL 0.37-0.41, PL 0.50-0.60, PW 1.00-1.07, AII 1.15-1.24, LL 0.90-1.24.

DISTRIBUTION AND HABITAT. From three islands of Vanuatu (Fig. 11). A single specimen has been collected on *Elatostema* sp. [as *Elastostemma*] (Urticaceae). The two specimens from Malekula Island were taken from vegetation. These data suggest that *V. crobylos* are 'up-on-plants', and occupy a different habitat than *V. howense*, a known epigaeic species.

REMARKS. *V. crobylos* and *V. rufescens* are morphologically alike, with both species being macropterous and primarily red in colour. The former species can be recognised readily by the hirsute frons and the pale ventral lateral aspect of the head. The male genitalia are significantly different, with the aedeagus of *V. crobylos* reduced, whereas the endosoma of *V. rufescens* (cf. Figs 12C and 15C) is an enlarged multifureate membranous sac, that has paired looped basal sclerites and spinose fields. The latter endosomal condition and the parameres are most similar to those found in *V. howense* (cf. Figs 12A and 14A).

### **Vanniopsis howense** sp. nov.
(Figs 2, 11, 13, 14, 16C,D)

ETYMOLOGY. For its geographical location.

MATERIAL. LORD HOWE ISLAND. Holotype, ♂, base of Intermediate Hill, 31°33'S 159°4'48"E, 6 December 2000, G Cassis (AM). Paratypes: 4♂♂ 2♀♀ 11 juveniles, same data as holotype; 1♂ 2♀♀ 2 juveniles, Goat House track at creek bed, 31°33'S 159°4'E, 5 m, 8 December 2000, G Cassis, ex fallen leaves of *Howea fosteriana* (AM); 6 juveniles, base of 'Round Face' Mt Lidgbird, Far Flats, 31°34'9"S 159°4'35"E, 27 November 2000, CBCR survey, ex leaf litter, Broad Megaphyllous Closed sclerophyll forest – *Howea belmoryana* habitat, site LHI36L (AM); 2 juveniles, N bank of Rocky Run Creek at junction of W costal trail to Boat Harbour, 31°33'19"S 159°5'33"E, 21 November 2000, CBCR survey, ex leaf litter, Broad Megaphyllous Closed sclerophyll forest – *Pandanus* habitat, site LHI24L (AM); 2 juveniles, S end of Salmon Beach, vicinity of Little Island, 31°34'8"S 159°4'28"E, 27 November 2000, CBCR survey, ex leaf litter, Broad Megaphyllous Closed sclerophyll forest –

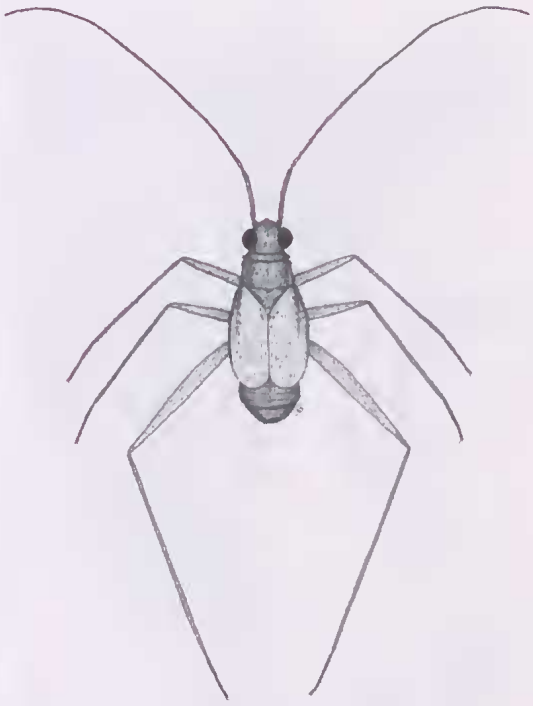

FIG. 13. Habitus of *Vanniopsis howense*.

*Howea fosteriana* habitat, site LHIS35L (AM); 1 juvenile, Mount Gower walking track, 31°35'12"S 159°4'35"E, 28 November 2000, CBCR survey, ex leaf litter, closed gnarled Mossy Forest - *Bubbia/Dracophyllum*, site LHI50L (AM); 2♂♂ 5♀♀, behind Leanda-Lei, [31°53'S 159°07'E], 45 m, 6 November 1979, GB Monteith, ex leaf litter, ealeareous soil Broad Megaphyllous Closed sclerophyll forest – *Howea fosteriana* habitat (QM).

DIAGNOSIS. Staphylinoid (Figs 2D, 13); forewings stramineous with red disruptive colouration; frons sparsely setate; antennae significantly longer than body (Fig. 13); pronotum (Fig. 2A) rectangulate, posterior margin rectilinear; pronotal collar moderately broad, anterior margin convex; mesoscutum concealed; legs greatly elongate; abdomen fuscous and polished; left paramere (Fig. 14A) without processes or flange; right paramere (Fig. 14B) truncate subapically with acute apex.

DESCRIPTION. *Colouration.* Body mostly stramineous-brown to brown, with banded antennae, pale legs, and fuscous abdomen. Head brown to fuscous, sometimes with obscure circular to linear stramineous markings on medial aspect of vertex, sometimes extending to inner margins of eyes. Clypeus, buccuiae, mandibular

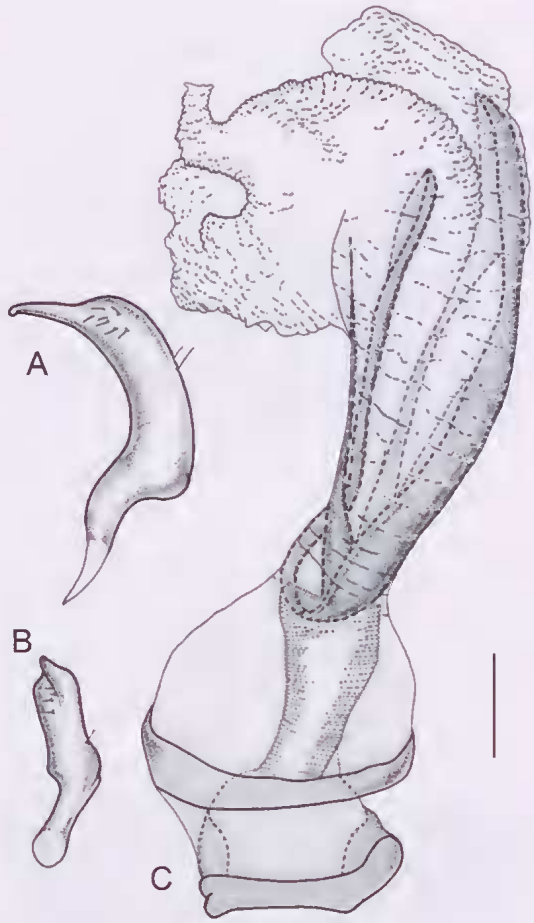


FIG. 14. *Vanniopsis howense*. A, left paramere; B, right paramere; C, aedeagus. Scale bar = 0.10mm.

and maxillary plates, genae and gular red to fuscous-red. Antennae: AI stramineous-red; AII mostly brown, with stramineous annulations basally, medially and apically, occasionally with reddish highlighting; AIII brown with apex stramineous. Pronotum brown to fuscous, most often with medial longitudinal stramineous marking; posterior margin occasionally with red highlighting. Scutellum fuscous, commonly with medial longitudinal stramineous marking, contiguous with pronotal medial marking, posterior quarter to third stramineous. Forewings stramineous to fuscous, with broad red markings medially and on medial margins. Legs stramineous; sometimes basal third of coxae fuscous; metafemora with subapical to apical red marking. Thoracic pleura and abdomen usually fuscous to red-fuscous. Abdomen fuscous-red to fuscous.

*Texture*. Dorsum smooth; abdomen polished.

*Vestiture*. Dorsum with moderate density of simple stout dark semi-erect setae. Frons without dense tuft of setae.

*Structure*. Habitus (Fig. 13). Staphylinoid (Figs 2D, 13). Pronotum (Fig. 2B) subrectangular; posterior margin rectilinear; pronotal collar moderately broad, anterior margin convex. Mesoscutum concealed. Labium reaching apices of metacoxae. Legs greatly elongate. Male genitalia: pygophore (Fig. 2E) subconical, genital opening large, ovoid, terminally oriented; left paramere (Fig. 14A) small, elongate, moderately elongate with hook-like apical process; right paramere (Fig. 14B) short truncate subapically with acute apical process coplanar with remainder of shaft; endosoma (Fig. 14C) with paired looped basal sclerites supporting membrane, secondary gonopore indistinguishable. Female genitalia: sclerotised rings (Fig. 16C) moderately large, semi-elliptical, mesial margin flattened; ventral labiate plate separated, pointed anteriorly flattened mesially; dorsal labiate plate folded dorsal to rings; posterior wall (Fig. 16D) with two bilateral pairs of thin inter-ramal sclerites.

*Measurements*. 5♂♂ BL 2.23-2.61, HW 0.55-0.66, IOD 0.27-0.30, HL 0.38-0.41, PL 0.39-0.43, PW 0.63-0.70, AII 1.46-1.72, LL 1.12-1.26; 5♀♀ BL 2.49-3.08, HW 0.64-0.69, IOD 0.30-0.31, HL 0.40-0.46, PL 0.41-0.47, PW 0.75-0.81, AII 1.41-1.56, LL 1.25-1.32.

DISTRIBUTION AND HABITAT. Primarily in lowland rainforest on Lord Howe Island (Fig. 11), in a range of vegetation classes (see Pickard, 1983 for floristics). A few specimens were also encountered in high altitude sites, in closed wet forests, including the *Bubbia/Dracophyllum* vegetation type of Mt Gower. One of us [GC] collected a large series of *V. howense* in Kentia palm habitat (*Howea fosteriana*), where it was found amongst fallen palm litter, in association with other heteropterans (*Atisne* sp. [Reduviidae], *Acaraptera* sp. [Aradidae] and rhyparochromid species). Their microhabitat was characterised by rotting leaf mould and abundant fungal mycelia.

REMARKS. *Vanniopsis howense* is distinct within the genus. Much of its distinctiveness is attributable to modifications that are commonly correlated with wing shortening, namely the compact body, simple pronotum (Fig. 2A) (short and subrectangular, narrower collar) and

scutellum (short and transverse). Like much of the epigaeic insect fauna of Lord Howe Island, this species is flightless and there are no known macropterous specimens.

Unlike *V. crobylos* and *V. rufescens*, this species has extremely elongate antennae (much longer than the body) and legs (Fig. 13). However, the state of the first antennal segment (compressed, arcuate, elongate and densely setate) (Fig. 13), is sufficient for its inclusion within *Vanniopsis*, as this is a putative synapomorphy for the genus. In addition, the simple male endosoma (lacking lobal sclerites and undifferentiated secondary gonopore) (Fig. 14C), is shared by the three constituent species of the genus. It should be noted however, that this endosomal type is also found in some species of *Vanniusoides*.

### **Vanniopsis rufescens** Poppius, 1909
(Figs 3C, 11, 15, 16E,F)

*Vanniopsis rufescens* Poppius, 1909: 17 (sp. nov.); Bergroth, 1920: 72 (list); Carvalho, 1952: 50 (type species); Carvalho, 1957: 33 (catalogue); Schuh, 1995: 39 (catalogue); Gorczyca, 1997: 540 (description)

MATERIAL. NEW CALEDONIA: 1♂, Mt Koghi[s], 22°11'S 166°01'E, 400m, 12-14 November 1986, RL Brown black light trap (BPBM); 1♂, Mt Koghi[s], 22°11'S 166°01'E, 15 February 1963, NLH Krauss (BPBM); 1♀, 7km S of Koh, 21°32'57"S 165°50'00"E, 31 January 1963, CM Yoshimoto (BPBM); 1♂ 2♀♀ 1 larva, 20°40'S 165°13'E, Ponandou intake, 100 m, 25 November 2001, GB Monteith, pyrethrum tree trunks (QM); VANUATU: 1♂, Erromanga Island, Port Narevin, 18°27'S 169°03'E sea level, 25 August 1979, ferns along streams (BPBM).

DIAGNOSIS. Macropterous (Fig. 3C); dorsum weakly rugose; frons sparsely hirsute; pronotum (Fig. 3C) campanulate, posterior margin bisinuate; pronotal collar broad, anterior margin rectilinear; mesoscutum exposed; peritreme moderately spout-like; two pairs of looped basal sclerites; left paramere (Fig. 15A) with basal and subapical processes; and, right paramere (Fig. 15B) with sub-basal process.

DESCRIPTION. *Colouration*. Body mostly pale red, sometimes with stramineous to stramineous-orange markings (Fig. 3C). Head stramineous-brown to brown, with posterior margin of vertex with red markings; frons and medial aspect of clypeus stramineous; lateral margins of clypeus, mandibular and maxillary plates, and genae red to red-orange; gular orange. Antennae: AI red; AII banded, dark brown with medial and apical stramineous bands, with base minutely stramineous; AIII mostly brown with apical

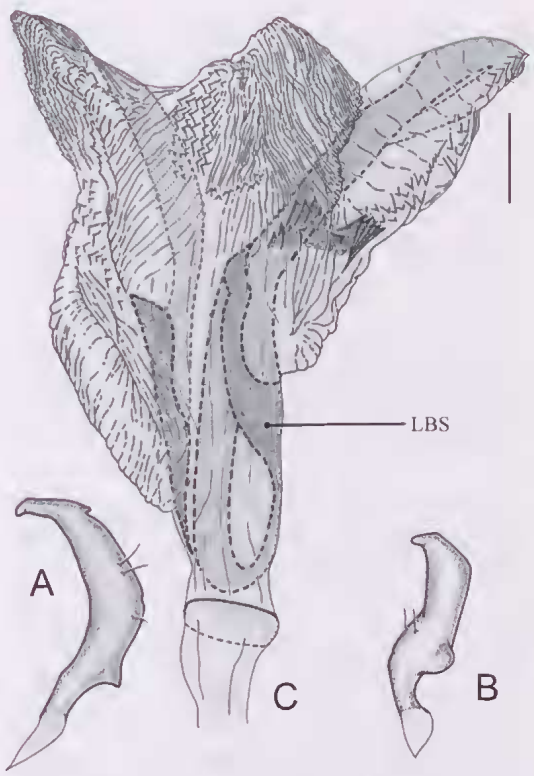


FIG. 15. *Vanniopsis rufescens*. A, left paramere; B, right paramere; C, aedeagus. LBS = looped basal sclerite. Scale bar = 0.10mm.

stramineous band; AIV brown. Labium mostly orange-brown; LI most often with red highlighting or more uniformly red; apex of LIV enbrowned. Thoracic pleura mostly red, often with propleura more brown to orange-brown with red highlighting. Mesoscutum and scutellum red to red-brown, sometimes with orange highlighting. Hemelytra mostly red, sometimes with lateral margins of clavus and exocorium more orange-red, or more variolate (Fig. 3C); medial angle of endocorium posteriad of claval commissure sometimes stramineous; cuneus orange-red, sometimes subapically red, sometimes apex and medial angle stramineous; membrane fumose; membrane veins red. Legs mostly stramineous to stramineous-orange; fore-tibiae sometimes with red highlighting distally; apical 1/4 of metafemora with red highlighting. Abdomen mostly red basally, more orange laterally and posteriorly.

*Texture*. Dorsum weakly rugulose.

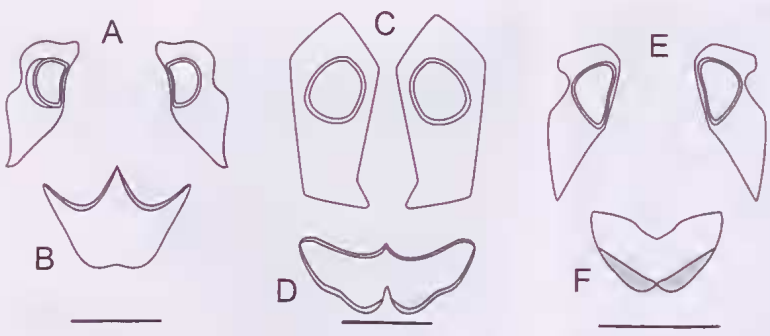


FIG. 16. Female genitalia. *Vanniopsis crobylos*. A, sclerotised rings; B, posterior wall; *Vanniopsis howense*; C, sclerotised rings; D, posterior wall; *Vanniopsis rufescens*; E, sclerotised rings; F, posterior wall. Scale bars, A-D = 0.25mm ; E-F = 0.20mm.

*Vestiture*. Head, pronotum and hemelytra with moderate to sparse distribution of elongate, simple, dark, erect, setae.

*Structure*. Habitus (Fig. 3C); Macropterous; elongate. Antennae subequal in length to body (Fig. 3C). Labium extending to apices of metacoxae. Pronotum (Fig. 3C) campanulate; collar broad, anterior margin rectilinear; posterior margin bisinuate. Mesoscutum exposed. Scutellum as long as wide. External efferent system of metathoracic glands spout-like; peritreme anteriorly oriented. Hemelytra: strongly depressed at corial fracture; cuneus narrow and elongate. Male genitalia: pygophore subconical; genital opening moderately large, subovoid, dorsally oriented; left paramere (Fig. 15A) small, elongate sensory lobe slightly produced, subapical dorsal margin with small tubercle, hook-like process apically; right paramere (Fig. 15B) small, sensory lobe slight expanded, subapical region slightly expanded dorsally, pointed apical process coplanar with remainder of shaft; endosoma (Fig. 15C) with two looped basal sclerites supporting membranes, also areas with spinose fields; secondary gonopore indistinguishable. Female genitalia: sclerotised rings (Fig. 16E) moderately large, widely separated, semi-elliptical, mesial margin flattened; ventral labiate plate separated, somewhat truncate anteriorly, flattened mesially, lateral margin excavated; dorsal labiate plate asymmetrically scroll-like laterally, right side larger than left; posterior wall (Fig. 16F) with bilaterally paired, thin inter-ramal sclerites on ventral margin.

*Measurements*. 3♂♂ BL 3.60-3.75, HW 0.61-0.62, IOD 0.22-0.23, HL 0.35-0.39, PL 0.48-0.50, PW 0.88-0.94, AII 1.26-1.28, LL 1.02-1.08; 3♀♀ BL 3.63-3.82, HW 0.60-0.63, IOD 0.22-0.23, HL 0.32-0.36, PL 0.48-0.50, PW 0.90-0.98, AII 1.07-1.20, LL 1.05-1.15.

DISTRIBUTION AND HABITAT. Vanuatu and New Caledonia (Fig. 11), with the majority of specimens collected from the latter. This species is known from the Northern (Espiritu Santo Island) and Southern districts (Erromanga Island) of Vanuatu, which spans much of the latitudinal range of the archipelago. In contrast, *V. crobylos* is restricted to islands of the Central and Northern districts of the same archipelago. *V. rufescens* is known from sea level to mid-altitude (400m) localities.

This species has been collected on ferns in a riparian habitat and from tree trunks. As with *V. crobylos*, these data suggest that *V. rufescens* is not epigaeic.

REMARKS. *V. rufescens* was described by Poppius (1909) from a single specimen collected from Espiritu Santo Island (Vanuatu). According to Gorczyca (1997), the specimen is badly damaged, with the abdomen missing. We have not been able to examine the holotype, however Gorczyca's description refers to the lateral and ventral aspects of the head as red in colour. This is the condition found in the specimens we have identified as *V. rufescens*, which distinguishes it from our new species, *V. crobylos*, which has these components of the head stramineous in colour.

These two species are alike but can be differentiated by the aforementioned head colour differences and the autapomorphic head vestiture in *V. crobylos*. These differences are supported by significant differences in the parameres (cf. Figs 12A,B and 15A,B) and aedeagus (cf. Figs 12C and 15C).

The sympatry of these two species in the Vanuatu archipelago (Espiritu Santo Island) is noteworthy. *V. rufescens*, aside from the type, is known from more southern latitudes (Southern district of Vanuatu, Lifou and New Caledonia), whereas *V. crobylos* is restricted to more northern districts of Vanuatu. This extrinsic information

casts some doubt on the separation of these speeies, however their morphologies are conclusive.

### Vanniusoides Carvalho & Lorenzato, 1978

*Vanniusoides* Carvalho & Lorenzato, 1978: 128 (gen. nov.); Schuh, 1995: 39 (catalogue); Gorczyca, 1996:337, 340 (note); 1997: 520, 537 (description); Gorczyca & Konstantinov, 2001: 107-110 (description).

TYPE SPECIES. *Vannius brevis* Poppius, 1909, by original designation.

DIAGNOSIS. Body smooth; pallid with disruptive red eolouration; frons weakly surpassing eyes dorsally; pronotal collar moderately broad, laterally restricted; antennae longer than body; first antennal segment a little longer than head length (Fig. 3A,B); first antennal segment weakly arcuate, not compressed nor densely setate; pronotum (Fig. 3A,B) campanulate; posterior margin of pronotum bisinuate; mesoseutum exposed; peritreme anteriorly oriented, spout-like; metafemora narrow and elongate; tarsal claws with subapical tooth; endosoma (Fig. 18C) without lobal sclerites, with pair of arcuate basal sclerites; left paramere (Fig. 18A) strongly arcuate; female with spinose posterior wall (Fig. 19B,D).

DESCRIPTION. *Colouration*. Body (Fig. 3A,B) mostly stramineous, dorsum with disrupted red-orange markings. Antennae not banded. Labium: LI mostly red; LIII-IV stramineous. Thoracic pleura mostly red or fuscous-red. Tibiae and femora either mostly stramineous and eoneolorous or stramineous and banded (red). Hemelytral membrane clear. Abdomen mostly stramineous with red markings.

*Texture*. Dorsum smooth.

*Vestiture*. Dorsum with moderate distribution of simple, decumbent, elongate setae.

*Structure*. Maeropterous (Fig. 3A,B); elongate. Head: vertex flat without longitudinal medial sulcus (Figs 3A,B); eyes enlarged, oceupying mueh of the lateral aspect of the head apically aeute or rounded; frons weakly expressed beyond eyes; mandibular plates enlarged, sometimes flattened, anteriorly direeted. Antennae: (Fig. 3A,B) significantly longer than body, thread-like; AI moderately swollen, weakly arcuate, cylindrical in cross-seetion (not compressed), a little longer than head; AII-AIV elongate, thin. Labium extending to apiees of metacoxae. Prontoum (Fig. 3A,B) transverse, campanulate; posterior margin bisinuate; pronotal collar flat, narrow, strongly narrowed laterally. Mesoscutum visible. Hemelytra (Fig. 3A,B) elongate, extending well beyond abdomen, depressed beyond euneal fraeture; cuneal fraeture weakly developed; euneus elongate, narrow. Proepisternum weakly depressed medially. Metathoraeic spiraele exposed, bounded by evaporative bodies. External efferent system: peritreme anteriorly oriented, tumid, spout-like. Legs elongate; metafemora elongate (Figs 3A,B), narrow, tapered distally. Tarsal elaws moderately areuate, eaeh with subapieal tooth. Male genitalia: parameres elongate, subequal in length; left paramere (Fig. 18A) with expanded sensory lobe; right paramere (Fig. 18B) elongate, sublinear, apex attenuated; phallotheea short; endosoma (Fig. 18C) either a membranous sae with a pair of small basal selerites or strongly sclerotised basal selerite with small terminal membranous sac, seeondary gonopore undifferentiated. Female genitalia: sclerotised rings (Fig. 19A,C) flattened, somewhat ovate, thin; ventral labiate plate widely separated; dorsal labiate plate mostly in one plane; posterior wall (Fig. 19B,D) mostly membranous, with thin bilateral inter-ramal sclerites; without inter-ramal lobes.

DISTRIBUTION. Northeastern Papua New Guinea, the Solomon Islands, Fiji Islands and Australia (north Queensland) (Fig. 17).

REMARKS. *Vanniusoides* does not have any eharacters that uniquely distinguish it, and is at present defined polythetieally. The male genitalia are somewhat simplified, with the endosoma (Fig. 18C) without lobal selerites, and eomposed of strap-like basal sclerites, with the secondary gonopore undifferentiated. In *V. melafrons*, the endosoma (Fig. 18C) is tube-like (basal selerites somewhat fused) and appears to be modified from the simple condition found in *V. clypeatus*, where the endosoma is a narrow membraneous sae supported by strap-like basal proeesses. This latter charaeter state is also found in *Vanniopsis crobylos*, and to some extent in *Vanniopsis howense*. The female genitalia are not suffieiently distinetive to separate *Vanniusoides* and *Vanniopsis*. These genera are best separated by external eharaeters. In *Vanniopsis*, the first antennal segment is eompressed and densely setate, charaeter states that do not oecur in *Vanniusoides*. Morcover, the vertex of the latter is not sulcate, in comparison to most other genera of the *Vannius* complex (ineluding *Vanniopsis*), aside from *Austrovannius*.

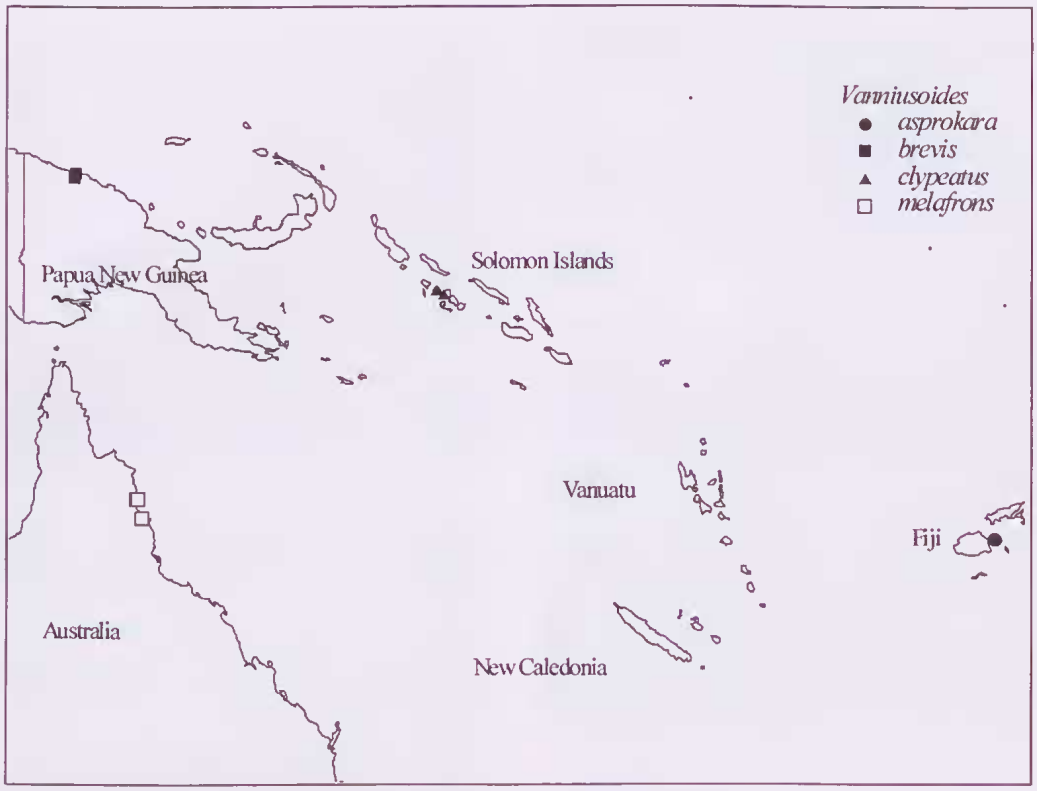


FIG. 17. Distribution map of *Vanniusoides*.

KEY TO THE SPECIES OF *VANNIUSOIDES*

1. Clypeus with distal tubercle . . . . . *brevis*
   Clypeus without tubercle . . . . . 2
2. Frons and clypeus fuscous to fuscous-red; propleura fuscous to fuscous-red . . . . *melafrons* sp. nov.
   Head uniformly stramineous, at most with minor red highlighting; propleura fuscous to fuscous-red or with reddish longitudinal band . . . . . 3
3. Lateral margins of pronotum with red markings (Fig. 3A); clypeus narrow and parallel sided, distally truncate; propleura stramineous . . . . . *asprokara* sp. nov.
   Lateral margins of pronotum entirely stramineous; clypeus distinctly broadened at base, distally rounded; propleura stramineous with transverse reddish band . . . . . *clypeatus*

**Vanniusoides asprokara** sp. nov.
(Figs 3A, 17, 19A,B)

ETYMOLOGY. Greek *aspros* (= white) and *kara* (= head), in reference to the stramineous head of this species.

MATERIAL. FIJI. Holotype, ♀, Thawathi, Ovalau, [17°38'S 178°49'E], 600-800 ft. [183-244m], 16 July [19]38, EC Zimmerman (BPBM). Paratypes: ♀, Draiba Trail, Ovalau, [17°42'S 178°48'E], 600-800 ft. [183-244m], 9 July [19]38, EC Zimmerman (AM); ♀, nr. Vuma, Ovalau, [17°40'S 178°49'59"E], 700 ft. [213m], 14 July [19]38, EC Zimmerman (BPBM).

DIAGNOSIS. Head uniformly stramineous; pronotum and hemelytra with distinct pattern of red markings (Figs 3A,B); apex of clypeus truncate, not expanded, without distal tubercle; metafemora stramineous with subproximal, submedial and apical red bands; tibiae uniformly stramineous.

DESCRIPTION. *Colouration*. Body (Fig. 3A) mostly stramineous with disruptive red markings on dorsum. Head: mostly stramineous, sometimes areas adjacent to antennal insertions with reddish highlighting. Antennae: AI mostly red, sometimes stramineous-red; AII stramineous, sometimes with obscure red tinge; AIII-IV stramineous-brown. Pronotum mostly stramineous, with lateral margins and medio-posterior region red; collar mostly stramineous, laterally red, rarely with medial red spot. Mesoscutum and scutellum mostly stramineous, with continuous medial red spot. Hemelytra stramineous with red markings; clavus

stramineous, with broad red longitudinal marking on anterior half medially; endocorium with two large medial red spots, subapex of embolium with narrow red marking; cuneus mostly stramineous with medial red spot. Legs mostly stramineous; coxae sometimes with red highlighting; femora stramineous with submedial and apical red banding; tibiae stramineous, sometimes with red stippling. Abdomen mostly stramineous, with lateral margins and subgenital regions red.

*Structure*. Habitus (Fig. 3A). Clypeus parallel-sided, apex truncate, without tubercles. Labium reaching metacoxae. Female genitalia with sclerotised rings (Fig. 19A) obscure, flattened, ovoid, thin, widely separated; ventral labiate plate widely separated; dorsal labiate plate undifferentiated; posterior wall (Fig. 19B) extremely membranous with bilateral inter-ramal sclerites in middle of membrane .

Males unknown.

*Measurements*. 3♀♀ BL 3.84-4.20, HW 0.61-0.65, IOD 0.24-0.25, HL 0.28-0.35, PL 0.34-0.37, PW 1.01-1.06, AII 1.90-2.08, LL 1.08-1.20.

DISTRIBUTION AND HABITAT. On Ovalau in the Fijian Islands (Fig. 17). The habitat is unknown.

REMARKS. *Vanniusoides asprokara* is distinguished from other species of *Vanniusoides* by the pattern of red markings on the dorsum (Fig. 3A); in particular the red lateral margins of the pronotum are unique to this species. In addition, this species has the propleura uniformly stramineous and the metafemora have red bands. The female genitalia are also distinct (cf. Fig. 19D).

**Vanniusoides melafrons** sp. nov.
(Figs 3B, 17, 18, 19C,D)

ETYMOLOGY. Greek *melas* (= black) and Latin *frons* (= forehead) referring to the dark front of the head.

MATERIAL. QUEENSLAND: Holotype, ♂, Cape Tribulation, 16°07.3'S 145°26.3'E, 28 March 2000, RL Kitching canopy fog (QM T108615). Paratypes ♀, Kuranda, [16°49'S 145°38'E], 13 March 1956, JL Gressitt (BPBM); ♀, Cooper Creek, 10 ml [16km] N of Daintree Riv[er], [16°08'S 145°27'E], 2 May 1970, GB Monteith (UQIC).

DIAGNOSIS. Frons and clypeus fuscous to fuscous-red; clypeus distally truncate, without tubercle; pronotum and hemelytra with distinct red patterning; metafemora stramineous with subproximal, submedial and apical red bands; tibiae with two submedial red bands; parameres

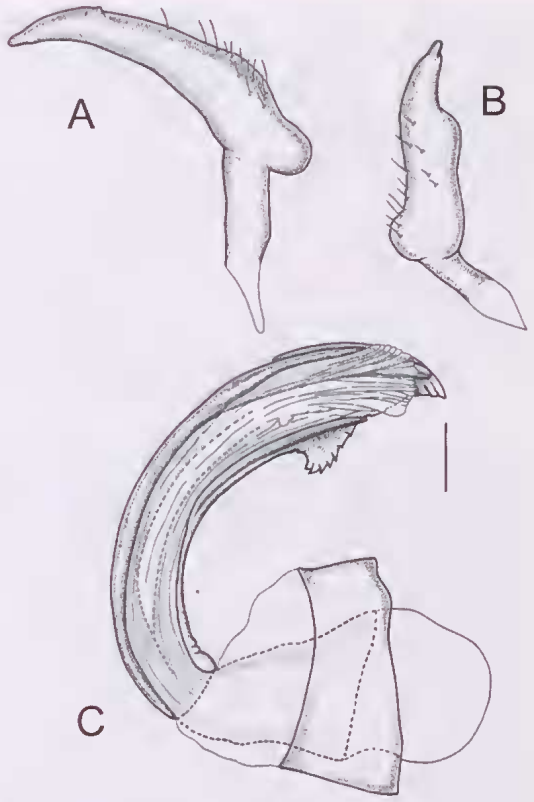


FIG. 18. *Vanniusoides melafrons*. A, left paramere; B, right paramere; C, aedeagus. Scale bar = 0.10mm.

(Figs 18A,B) elongate; endosoma (Fig. 18C) strongly sclerotised with serrate apical flange.

DESCRIPTION. *Colouration*. Body mostly stramineous with disruptive red markings on dorsum (Fig. 3B). Head: vertex stramineous, remainder of head red to fuscous-red (Fig. 3B). Antennae: AI red; AII stramineous, sometimes with red highlighting; AIII-AIV stramineous to stramineous-brown. Pronotum mostly stramineous with pair of submedial caudal red spot (Fig. 3B). Thoracic pleura fuscous to fuscous red, sometimes metepisternum more red-brown. Mesoscutum and scutellum mostly stramineous with pair of sublateral red spots. Hemelytra mostly stramineous, with distinctive red patterning (Fig. 3B); clavus with inner margins and apices red; endocorium with broad red band adjacent to clavus, red spots on endocorial angle, subapex of embolium and posteriad of R+M. Legs mostly stramineous; coxae either mostly brown with apices

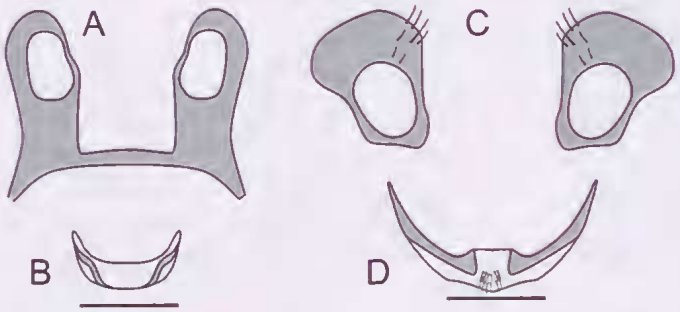


FIG. 19. Female genitalia. *Vanniusoides asprokara*. A, sclerotised rings; B, posterior wall; *Vanniusoides melafrons*; C, sclerotised rings; D, posterior wall. Scale bar = 0.25mm.

stramineous or more uniformly pale; meta femora stramineous with subproximal, submedial and apical red bands; tibiae with two submedial red bands. Abdomen mostly stramineous with lateral margins and subgenital regions red.

*Structure*. Habitus (Fig. 3B). Clypeus parallel-sided, apex truncate, without tubercles. Labium extending just beyond apices of metacoxae. Male genitalia: left paramere (Fig. 18A) elongate with expanded sensory lobe and acute apex; right paramere (Fig. 18B) elongate, abruptly constricted subapically, apex pointed; endosoma (Fig. 18C) tube-like, formed by pair of strongly sclerotised basal sclerites, one strap with terminal serrate flange, membranous sac terminal. Female genitalia: sclerotised rings (Fig. 19C) flattened, obscure, circular, thin, widely separated; ventral labiate plate widely separated with strong spinules; dorsal labiate plate basically flattened, spinose, simple, adhering to floor of genital chamber; posterior wall (Fig. 19D) thin, membranous with strong spinules mesially and bilateral inter-ramal sclerites dorsally.

*Measurements*. 1♂ (Holotype) BL 3.2, HW 0.61, IOD 0.17, HL 0.37, PL 0.40, PW 1.01, AII 1.74, LL 1.25; 2♀♀ BL 4.10-4.30, HW 0.60-0.62, IOD 0.17-0.19, HL 0.34-0.37, PL 0.33-0.34, PW 1.08, AII 1.76-1.80, LL 1.34-1.40.

DISTRIBUTION AND HABITAT. Rainforests of the wet tropics of northeast Queensland (Fig. 17).

REMARKS. The fuscous front of the head differentiates this species from *V. asprokara* and *V. clypeatus*, both of which have pale heads. Moreover, the hemelytra have more red markings (cf. Fig. 3A,B). The male genitalia of *V. melafrons* and *V. clypeatus* are the only species investigated to date, and their morphologies differ, with the former species having a tube-like endosoma (Fig. 18C).

### Vanniusoides clypeatus
Gorczyca & Konstantinov, 2001
(Fig. 17)

*Vanniusoides clypeatus* Gorczyca & Konstantinov 2001: 108 (sp. nov.).

MATERIAL. SOLOMON ISLANDS: 1♂, New Georgia Island, Munda, 0-100m, XI-1980, N.L.H. Krauss coll. (BPBM).

REMARKS. This species is distinctive because of the highly autapomorphic condition of the clypeus and mandibular plates, which are both rounded apically. The male genitalia are identical to those illustrated by Gorczyca & Konstantinov (2001). These authors have provided a detailed description of the species and we have opted against providing a redescription.

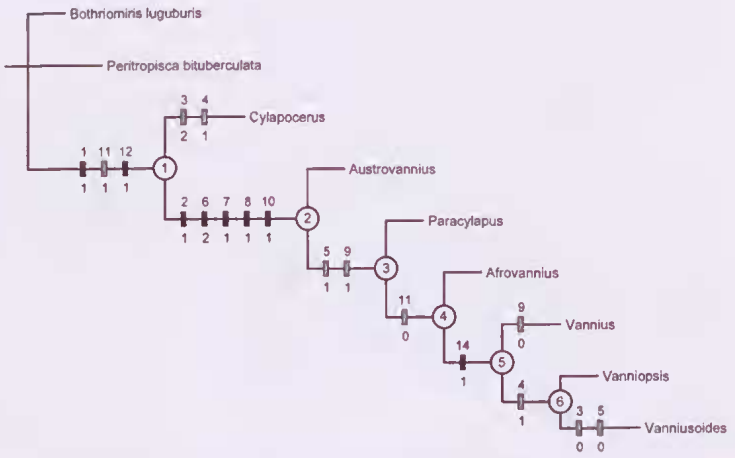


FIG. 20. Cladogram of genera of *Vannius* complex. Synapomorphies = black boxes; homoplasies = grey boxes. Superscript numerals = character number; subscript numerals = character state. Numerals in circles = node number. Length = 30 steps. Consistency index = 0.70. Retention index = 0.70.

TABLE 1. Characters and character states of the *Vannius* complex and outgroups.

1. Head orientation: horizontal (0); dorsoventral (1).
2. Frons and clypeus: bilobed (0); coplanar (1).
3. Vertex: without medial sulcus (0); with shallow sulcus (1); with deep sulcus (2).
4. Antennal segment I: shorter or subequal to head length (0); significantly longer than head length (1).
5. Antennal segment II: concolorous (0); banded (1).
6. Pronotal collar: absent (0); rounded and thin (1); flat and broad (2).
7. Dorsum commonly with disrupted red colouration: no (0); yes (1).
8. Metafemora: moderately elongate (0); greatly elongate (1).
9. Pretarsal claws: without subapical tooth (0); with subapical tooth (1).
10. Parempodia: setiform (0); spatulate (1).
11. Secondary gonopore: indistinguishable (0); well-sclerotised, with spinose aperture (1).
12. Endosoma: without basal sclerites (0); with basal sclerites (1).
13. Endosoma: without lobal sclerites (0); with lobal sclerites (1).
14. Basal sclerite: free from base of endosoma, not fused (0); extending to apex of endosoma, fused and somewhat bent (1).
15. Sclerotised rings: thin, not strongly bent, without projections from lateral and mesial margins (0); thick, somewhat strongly bent, with projections from lateral and mesial margins (1).
16. Ventral labiate plate: separated medially (0); joined on anterior margin (1).
17. Dorsal labiate plate: not expanded lateral of sclerotised rings (0); expanded lateral of sclerotised rings, lateral most margins scroll-like (1).
18. Inter-ramal sclerite: divided, structure formed of two thin sclerites (0); completely spanning base of first valvifer (1).
19. Inter-ramal lobes: absent (0); present (1).

## PHYLOGENETICS

These results are based on an analysis of the six genera of the *Vannius* complex and three outgroups within the Cylapinae, including exemplars of the Bothriomirini (*Bothriomiris lugubris*), Fulviini (*Peritropisca bituberculata*) and Cylapini (*Cylapocerus*). The characters and character states are given in Table 1 and the data matrix in Table 2. A single cladogram of minimum length (30 steps) was obtained with a consistency index of 0.70 and a retention index of 0.67. The discussion of sister groupings is based on the synapomorphies shown in Fig. 20.

Node 1 – The Cylapini are defined in this analysis by the dorsoventral head (1-1), secondary gonopore sclerotised with a dentate aperture (11-1), and the endosoma with basal sclerites (12-1). Neither of these characters are exclusive to the Miridae, but are not found in the exemplars of the other recognised supragenerie groups of Cylapinae (Bothriomirini and Fulviini) that were examined. Some representatives of the Fulviini (e.g. Kelton, 1959) are known to possess basal sclerites, and this is not considered to be a reliable synapomorphy for the Cylapini, although the basal sclerites of the latter tribe are often strap-like. Further investigation is required to determine if the 'basal sclerites' character can be differentiated to identify additional synapomorphies. The secondary gonopore varies within the ingroup and this character is homoplasic in this analysis.

Node 2 – The *Vannius* complex is defined by the following synapomorphies: gular and the frons and the clypeus in the same plane (2-1); pronotal collar broad and flat (6-1); dorsum with disrupted colouration (7-1); metafemora greatly elongate (8-1); and, parempodia spatulate (10-1). The derived states of characters 7 and 8 are also found in other members of the Cylapinae, and require further investigation beyond the outgroups that were examined. The coplanar frons + clypeus is also deserving of more investigation, particularly for taxa such as *Cylapus* Say and its relatives, but is unlikely to be upheld as a synapomorphy for the *Vannius* complex. The spatulate parempodia remain the most conclusive synapomorphy for the *Vannius* complex, and is unknown for all other examined cylapines. As noted above, the condition also occurs in *Palaucoris*, a few taxa of Termatophylini (Deraeocorinae) and Phylinae, but these are undoubtedly independent derivations. The broad and flat pronotal collar is also considered to be a credible synapomorphy, as the pronotal collar in the Cylapini is at most narrow and more rounded.

Node 3 – In this analysis, *Austrovannius* is sister-taxon to the remainder of the *Vannius* complex. The latter subset is defined by the banded antennae (5-1) and tarsal claws with subapical teeth (9-1). Both of these characters exhibit homoplasy, with *Vannius* lacking subapical teeth (5-0) and *Vanniusoides* possessing concolorous antennae (9-0).

Node 4 – *Paracylapus* is the next most basal taxon of the *Vannius* complex. The remaining genera are united by a single homoplasic character; secondary gonopore indistinguishable (11-0).

Node 5 – *Afrovannius* is sister-taxon to the rest of the *Vannius* complex. *Vannius* + (*Vanniopsis* +

TABLE 2. Charaeter matrix of three outgroups (*Bothriomiris lugubris*, *Peritropisca bituberculata* and *Cyalpocerus* sp.) and six genera of the *Vannius* complex against 19 charaeters. Missing data = ?

| Character | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Bothriomiris lugubris* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ? | 0 | 1 | ? | ? | ? | ? | 1 | 1 | 0 |
| *Peritropisca bituberculata* | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | ? | ? | ? | ? | 0 | 0 | 1 |
| *Cylapocerus* | 1 | 0 | 2 | 1 | 0 | 0 | 0 | ? | 0 | 1 | 1 | 0 | 0 | ? | ? | ? | ? | ? | 1 |
| *Afrovannius* | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | ? | ? | ? | ? | ? | 2 |
| *Austrovannius* | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 2 |
| *Paracylapus* | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | ? | ? | ? | ? | ? | 2 |
| *Vanniopsis* | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | ? | 0 | 0 | 1 | 0 | 0 | 2 |
| *Vannius* | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | ? | ? | ? | ? | ? | 2 |
| *Vanniusoides* | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 2 |

*Vanniusoides*) are a elade on the basis of one synapomorphy; basal selerites extending to apex of endosoma (14-1). This represents the most supported in-group elade within the *Vannius* complex. These three Eastern Hemisphere genera are also saliently alike, and it is predicted that additional synapomorphies will be found for this elade.

Node 6 – *Vanniopsis* and *Vanniusoides* are united on the basis of a single homoplasic charaeter; first antennal segment significantly longer than the head (4-1). In addition, these taxa also exhibit similar male genitalia, with the endosoma having basal sclerites and laeking lobal sclerites.

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